

TESTED: LG G4 + NABU X FITBAND

TECH » SCIENCE » WHEELS » HOME » OUTSIDE

www.popularmechanics.co.za

Popular Mechanics



AUGUST 2015
RSA: R34,90

Other countries:
R30,61 excl VAT



HOW HOLOGRAMS ARE CHANGING OUR WORLD

- Medicine
- Military
- Elections
- Showbiz

APPLIANCES
THAT TALK
TO EACH OTHER –
AND US, KIND OF

EDDIE VAN HALEN

INSIGHT FROM A ROCK
LEGEND, INVENTOR AND
INSATIABLE TINKERER

SKILLS

- SMART STORAGE
- HOME Q&A
- TAKEN APART: CHAINSAW

SWEAT ETHIC

- BIKING
- FITNESS
- HIGH-TECH BOK KIT



WEARABLES

Stupid or amazing?

UPGRADE

Uber-fitwatch

Great gadgets

Reviewed

ISSN 1682-5136

08157



9 771682 513003

ANSWER THE CALL OF THE WILD.

And anyone else who calls.

SMART TECHNOLOGY

- SYNC® with Bluetooth® and voice control
- Dual Zone Climate Control
- Cruise Control
- Steering Wheel Audio Controls



www.ford.co.za
Visit FordSouthAfrica



car

**TOP 12
BEST BUYS
2015**

WINNER

Best Double Cab
Bakkie



CONTENTS

Popular Mechanics

AUGUST 2015 VOL 14, NO 1 |

| BE THE FIRST TO KNOW



50



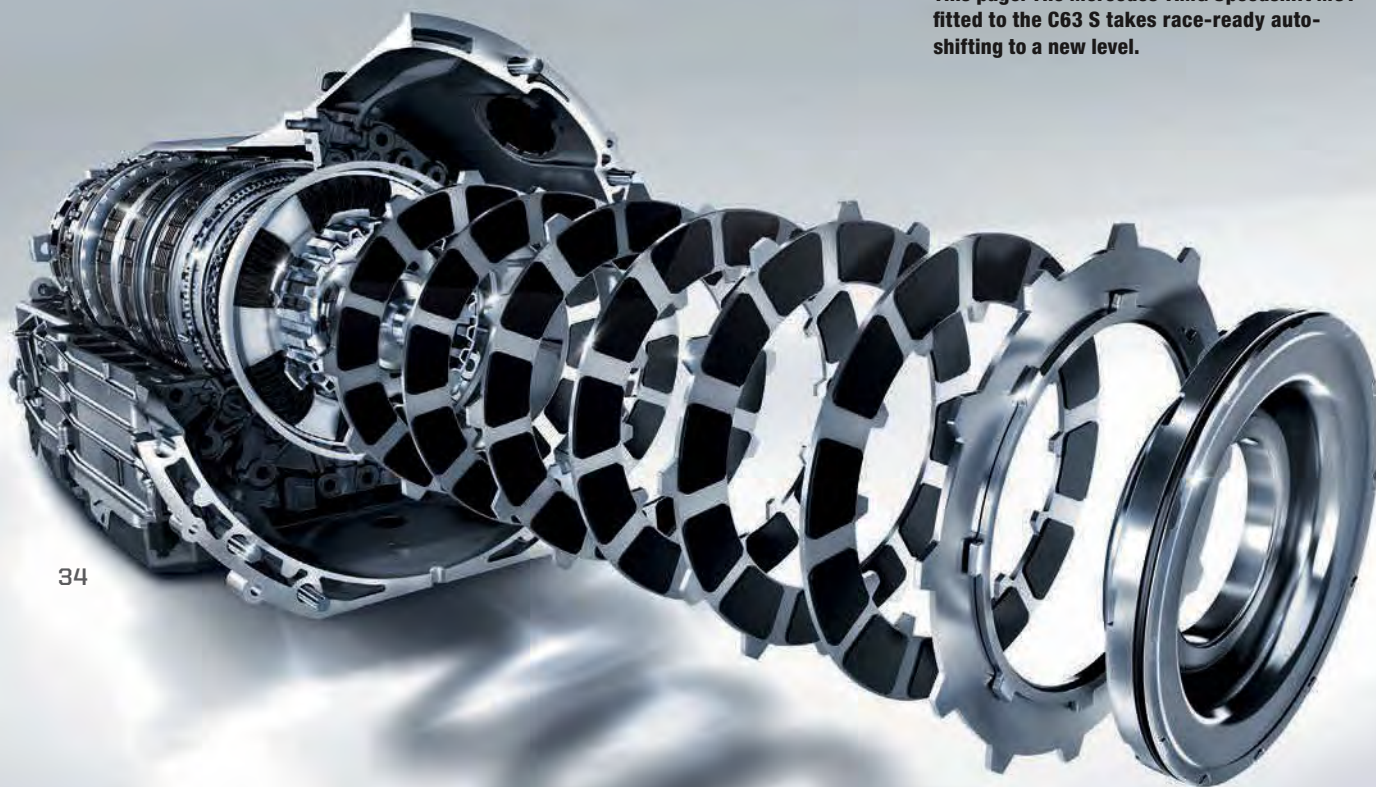
68



80

Cover: Hologram technology is changing the way the armed forces operate, the way people elect their leaders, and the way entertainers – living and dead – bring us joy.

This page: The Mercedes-AMG Speedshift MCT fitted to the C63 S takes race-ready auto-shifting to a new level.



34

TESTED



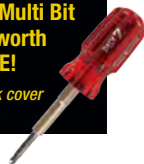
66



**SUBSCRIBE
AND SAVE 25%**
12 issues for just R314

You'll also receive a Dash
7 Quick Change Multi Bit
Screwdriver worth
R110, FREE!

(See inside back cover
for details).



HOW YOUR WORLD WORKS

- 16 • Wearables – stupid or amazing?
• Spy on a mako shark
• Identify a Michelangelo
• How close are we to transferring consciousness?

SCIENCE

- 28 **Holograms are people, too**
On the frontlines of the other reality

FEATURES

- 22 **Great unknowns**
46 **Eddie van Halen is a god**
Guitar legend, rock star – and tinkerer
50 **Sweat ethic**
• The one bike that does it all
• Ultimate DIY bike valet
• E-bike, tested
• Science of sports injuries
• Springbok clothing tech
56 **The Daily Miracle**
How *The New York Times* gets the news out
82 **A Beautiful Thing**
Louisville Slugger: turning timber into home runs
84 **The landing**
Learning to fly, Part 3

WHEELS

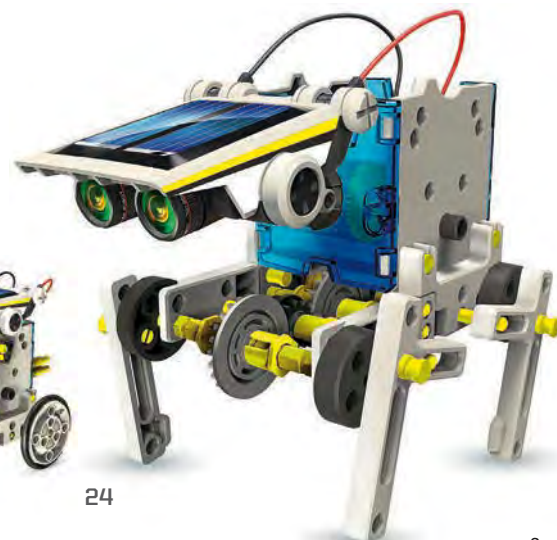
- 34 • The best automatic gearbox, right now
• The world's most expensive car show
• Expensive toys
• Ford's mightiest V8 ever
• Customising a bike



34



24



TECHNOLOGY

- 42 **Let's chat**
Smart appliances that talk to each other – and us

TESTED

- 66 Nabu Razr X fitband
LG G4 smartphone

SKILLS

- 68 • Taken apart: chainsaw
• Fuel line repair
• Home Q&A
• Project: smart storage
• Project: rocket pencil case
• DIY Challenge
• Kids' project: water shooter
• Shop notes

UPGRADE

- 80 Aviatore Veloce espresso maker
Frederique Constant horological smartwatch

MONTHLY

- 4 Credits
6 From the editor
10 Letters
14 Time Machine
24 Great Stuff
104 Do it your way



46

► SUBSCRIBE NOW!

Popular Mechanics

BE THE FIRST TO KNOW

EDITOR: Anthony Doman GROUP PUBLISHER: Neil Piper

EDITORIAL TEAM

Associate editor Sean Woods
Journalist Lindsey Schutters

PRODUCTION AND CREATIVE TEAM

Group production manager Keryn Rheeder
Production manager Gronja Lennox
Art director Thea Woodman
Designer Sharon Gunst
Group smalls designer Relic Wessels
Webmaster Nikky Oosthuizen
Group digital designer Bianca Liebenberg
Group developer Cicero Joseph

BUSINESS AND SALES TEAM

Group national sales manager André Stadler
Group digital business manager Wendy Lucas
Sales manager Jesse Henney
Advertising sales executives Gauteng – Joanne Thompson,
Patrick Kennedy, Nicky Lloyd,
Jackie Browning, Natasher Black
Durban – Lindi van den Heever
Cape Town and PE – Ingrid Versfeld
Advertising sales co-ordinator Linda Delpert
Group marketing services analyst Thembi Mokoena
Media strategist Nokuthula Nkosi
Campaign managers Nawhaal Fakir

MARKETING, EVENTS AND CIRCULATION

Group marketing and sponsorship manager Dean Dicks
Group promotions manager Chanelle Vivian
Subscriptions marketing manager Lizl Joseph
Promotions manager Amanda Africa
Group circulation and marketing designer Lauren de Sousa
Group show and events operations manager Kathryn Frew
Group show and events sales consultant Hanneke van Niekerk
Subscriptions operations Karin Mulder
Subscriptions administration Lynn Heiberg



GROUP SUPPORT

Chief operations officer Werner Schmidt
Finance manager Zandre Gorgosilich
HR officer Emmelia Fouché
IT manager Alex Chetty

DIRECTORS

Paul Jenkins (Chairman), Tim Holden, Terry Moolman, Neil Piper,
Werner Schmidt, Cornelios Vamvadellis, Anton Botes, Jacques Breytenbach

PUBLISHED BY RamsayMedia (PTY) LTD

Company registration number: 1934/005460/07 ISSN number: 1682-5136

Cape Town head office: Uitvlugt, 3 Howard Drive, Pinelands, 7405

P O Box 180, Howard Place, Western Cape, 7450

Tel: 021 530-3100, Fax: 021 531-9495

Gauteng office: Caxton House, 368 Jan Smuts Avenue, Randburg, 2196

P O Box 78132, Sandton, Gauteng, 2146

Tel: 011 449 1100, Fax: 011 449 1104

Email address: popularmechanics@ramsaymedia.co.za

www.ramsaymedia.co.za

HOW TO SUBSCRIBE OR CONTACT US

Call: 0860 100 205, Fax: 0866 704 101 or 021 530 3143,

E-mail: subs@ramsaymedia.co.za

Online: www.magsathome.co.za or www.popularmechanics.co.za

Web site: www.popularmechanics.co.za

FOR OUR CURRENT SUBSCRIPTION RATES, SEE INSIDE BACK COVER

Published and distributed by RamsayMedia (Pty) Ltd by permission of Hearst Communications Inc, New York, New York, United States of America.

We cannot be responsible for loss of unsolicited queries, manuscripts or photos. For return, they must be accompanied by adequate postage. As a service to readers, POPULAR MECHANICS publishes newsworthy products, techniques and scientific and technological developments. Due to possible variance in the quality and condition of materials and workmanship, POPULAR MECHANICS cannot assume responsibility for proper application of techniques or proper and safe functioning of manufactured products or reader-built projects resulting from information published in this magazine.

abc Total monthly sales: 39 666 (January-March 2015)

www.popularmechanics.co.za _ AUGUST 2015



SAVE 30%
12 DIGITAL ISSUES
FOR JUST R147

ACCESS **ANY** TIME,
ANYWHERE.

Visit www.popularmechanics.co.za/subscribe

Single issues are also available.

Be sure to rate & review us!



This offer closes 31 August 2015. Other subscription gifts and prizes do not apply to this offer. By providing your details, you give Popular Mechanics permission to communicate with you via email or SMS.

MAKE it
POSSIBLE



Ignite ∞ Creativity



Capture HD video from 4 different angles using **Director Mode**.



Create one of a kind **Light Painting** on the super sleek **5.2" HD screen**.



Capture brilliant pictures with a **13MP** camera at lightning speed with the **Octa-core processor**.



Be secure with **Huawei Select** which offers you screen and board replacement. T&C's apply.



HUAWEI **P8**

HUAWEI
CULTURE
Club

#IgniteP8
consumer.huawei.com/za



App available from Play Store or IOS

Product colour, shape and interface are for reference only. The actual product may vary. UI functions and applications may vary by region.

THE OFFICIAL
SMARTPHONE SUPPLIER
TO RUGBY





Yes, people, you can drive the Harper Type 5 on our roads. Just be prepared for some strange looks.

OLD VS NEW

THE RADIO WAS FULL OF Uber, taxis, buses, strikes and threats of violence as I threaded my way over Ou Kaapse Weg. After all that angst, then, it was a relief to simply get to meet someone who views driving a motor vehicle as something that ought to be a pleasure in itself.

Of course, it helps that the cars Craig Harper designs and builds are created for the race track. But that's not where it ends: Harper has a refreshingly different take on things.

There are those who design road cars good enough to go head to head on the track – and you'll read about some of them in our Cars section – but the man I met makes racing cars that are perfectly capable of being driven on the road. Driven, mind you, not raced. But that's a story for another day. (That day being quite soon, actually.)

For now, to return to where I started this train of thought, I can state upfront that my experience with Uber – prompt, professional, price-sensitive – has left me with a distinctly jaundiced view of the metered taxi industry and those who purport to regulate it. And of course we'll be seeing much more of this Old vs New stuff as our world becomes ever more connected, despite the best efforts of authoritarian governments. The World

Wide Web and the law of unintended consequences are forcing all of us, and the magazine business is not exempt, to rethink the way we operate.

BEING THE OFFSPRING of a newspaperman, it was almost inevitable that I would spend my Saturday afternoons and evenings surrounded by grizzled veterans bellowing, "Copy Boy!" Occasionally, we kids were allowed to "help" the messengers send screeds of copy paper to the Works via vacuum tube transport, accompany our seniors to the basement where the presses thundered, and generally develop a wholly unrealistic view of the romance of newsprint and the power of ink. In time, my laboured schoolboy syntax even made it into print. It's a love affair that has not faded these five decades later.

So I must confess to a soft spot for *The Daily Miracle* (Page 56). Investigating the engine room, the brain and the soul of *The New York Times*, it follows the journey taken until that moment when – *thud!* – the morning paper arrives. This "monster, sprawling organisation, the most influential print newspaper and digital news site in the world" still, after all, makes most of its money by selling paper.

WE ARE STEADILY TICKING the boxes heading towards late October in preparation for the 2015 edition of **FutureTech**. This year, our annual feast of the cutting edge, the amazing and the overall rather important is due to be held in Gauteng. The theme: **Driving Innovation**. We hope to bring you details in our September issue, due out at the end of August.

Anthony

anthony@ramsaymedia.co.za

COMPETITION WINNERS...
Details online at www.popularmechanics.co.za



► THE NEW FORD FOCUS WITH ECOBOOST
THINK OF IT AS LEAN MUSCLE.

Introducing the all-new Ford Focus, with award-winning EcoBoost technology.

Turbo charging gives you more power and a rush of adrenaline. Direct fuel injection provides exceptional fuel economy. Add smart technology and sleek design to a car that has proven itself a firm favourite around the world – and be prepared for it to become your favourite too.



www.ford.co.za
Visit FordSouthAfrica



Go Further

Handcrafted by racers.

The Mercedes-AMG GT S. Visit www.mercedes-amg.co.za

Vehicle specifications may vary for the South African market.



AMG
DRIVING PERFORMANCE



Mercedes-Benz



WINNING LETTER

POWER DOWN THE DRAIN

Stormwater and groundwater flowing into the sewer system can have serious consequences for load shedding. I speak from experience; in the sanitation department of a big municipality, it became clear to me how widespread and serious a problem this is. Readers – even municipal officials – may ask, “But what has this to do with load shedding?”

Design of sewer reticulation systems and sewer pump stations makes a nominal provision for stormwater inflow (normally around 15 per cent).

Property owners are often not aware that allowing stormwater to enter the sewer reticulation is illegal and may lead to prosecution. As properties develop, larger areas are covered by building extensions and paving.

Often the easy (“cheaper”) solution is to allow the stormwater run-off to drain into a sewer gully or even, via a dedicated connection, into the sewer.

But this practice has huge and continual operational and financial implications for the municipality – and, eventually, the ratepayer. The pumps in the sewer pump stations consume a lot of electricity and come on only on demand, when the sumps are nearly full.

When the inflow of stormwater increases this flow beyond the design capacity, the pumps have to stay on until the incoming flow has decreased. Often the pumps cannot cope and pump stations overflow into nearby rivers and streams.

In addition to this, when the now increased volume of sewage reaches the treatment plant, it has to be treated, again at an increased consumption of electricity and increase in cost.

Compounding facts to consider:

- When the flow exceeds the capacity of the sewer pipes, the result is overflowing manholes, with an obvious negative pollution impact.
- The uncontrolled flow from manholes may further cause erosion damage, which has to be repaired at a cost to the ratepayer.
- The municipality may be forced to put in larger pipes to allow for the extra flow and to mitigate serious damage.

If you are serious about reducing electricity consumption and costs, confirm that the stormwater run-off on and from your property does not enter the sewer system.

DOUW KRUGER
RANDBURG

Write to us, engage us in debate and you could win a cool prize. This month's best letter will receive a HTSE watch developed by TITAN, valued at R3 750. HTSE, or High Tech Self Energized, is a collection of futuristic, light-powered watches developed by TITAN. These watches can be charged by any light upwards of 200 Lux. HTSE's design inspiration is from some of the most complex self-energising bodies built by mankind: space ships, orbiting space stations and satellites. HTSE watches' impressive array of features includes End of Life (an indicator of battery charge), Sleep Mode (increases shelf life of the battery) and Over Charge Prevention (protects the battery). HTSE – for those driven by technology. To find out more, contact Luxco on 011 448 2210 or www.luxco.co.za

Send your letter to: POPULAR MECHANICS, PO Box 180, Howard Place 7450, or e-mail popularmechanics@ramsaymedia.co.za Please keep it short and to the point. Regrettably, prizes can be awarded only to South African residents.

DOES SEQUENTIAL SWITCH-ON MAKE SENSE?

Instead of powering all the lights and appliances in the house at the same time at high cost, why not design a sequential system? Let's say it starts in the morning with the deep freeze for two hours, then the fridge, then the tumble dryer, etc. Surely this could save on the output needed at one particular time? Lights, TV, PC and so are minimal by comparison when these big boys are taken care of; in so doing, the size and cost of an off-grid system can be drastically reduced.

Is there anyone who can design and build this?

TOMMY NDLOVU
BY EMAIL

GYM POWER - AND MORE

“Use trucks to power the grid” (Letters, April 2015) really got me thinking of the potential for awesome ideas to feed power to the grid.

I read of a track in Holland where solar panels in a cycle path are being tested to see if they are viable. If this works, hundreds of cycle paths used by thousands of riders daily could help to put power back into their grid.

The other day I was sitting on an exercise bicycle in the local gym, pedalling away. All sorts of exercise machines were around me, all generating a lot of sweat! Could they be used to generate enough power to take a gym out of the grid?

On the news I saw couples dancing on a flexible moving floor that lit up the Eiffel Tower in Paris at night.

Could our four biggest storage dams not be modified to drive turbines like the Drakensberg pumped storage scheme? Sadly, the Ingula scheme in the Drakensberg is way behind schedule.

How about devoting one page per issue to alternative energy matters and help to users of Eskom power, like the winning (and very helpful) letter in your May issue? Your magazine could become a forum of ideas to help save our national grid?

BRYAN INNES
BY EMAIL

(Readers, what do you think? – Editor)

HAVE THAT SPRAIN CHECKED

In “Small torque” (April 2015, Do It Your Way), Chris Graham refers to a sprained wrist caused by a cordless drill driver. I'm worried on his behalf.

His injured wrist pain could well be due



Perfect for office and home use 'Safes you can trust'

Our personal possessions are worth more to us than to anyone else, especially if they are sentimental, and that is why we understand the importance of prevention and security...

When it comes to safes, Yale offer the widest range using the latest security technologies in varying sizes. From special application safes, to Professional and Fire safes or the latest Burglar Resistant safe, Yale has a solution that will combine security and convenience for your particular needs.

Like the new Extra Large Home / Office solution safe which fits snugly under a desk and with its adjustable shelf, allows you to store A4 files, a handbag, laptop and 20 keys. It's the perfect solution for open plan offices and multi-functional home use.

For dedicated laptop and tablet storage, Yale offers a variety of laptop safes as well as a tablet safe which is removable from a mounting for people on the move.

You will most definitely find a home and office safe in our range which will suit your security needs.



Home, office, fire and application safes to suit your security needs. For more information or to Buy Online, visit our website www.yalelock.co.za or call us on 011 761 5000 and ask to speak to a Yale Sales Consultant.



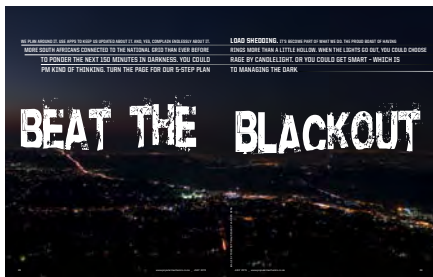


to a fractured scaphoid bone if the pain was above the thumb. If he still has any twinges there, especially when twisting it, he should get it X-rayed with a "scaphoid view" (taken at a particular angle). It is a small dumbbell-shaped bone in the wrist, larger at each end, with a narrower waist that fractures easily with a twisting force. It heals well if immobilised promptly.

Many years ago, when still working, I had a patient (I'm a retired doctor) who worked for a major drinks company maintaining their vending machines. He was wrongly issued with a drill with no clutch, hurt his wrist as Chris describes, coped with the slow recovery and kept at work, and then it went again 18 months later. An X-ray showed an 18-month-old, poorly healed fracture with arthritis settling in. It required removal of the bone and replacement by an artificial one – and the drinks company had to pay compensation, as it was clearly their fault.

Far better to avoid that by earlier diagnosis, though some time must have elapsed by now to get him into print and over to me in the UK!

ROBIN WILSON
BY EMAIL



YOU'RE AGGRAVATING LOAD SHEDDING

I was disappointed that *Beat the Blackout* (July 2015) featured a DIY inverter installation. You do realise that plug and play inverters are a cause, not a solution? When the power comes back on, people run their normal load and try to recover the energy they used during the load shedding, effectively doubling the strain on the network. With sterling advice like this, national blackout here we come.

I am busy taking 2 000 houses off the grid, the right way, in Parkhurst and am happy to discuss this with you.

RYAN BEECH
GAUTENG

AVERAGE SPEED TRAPPING: RISKY?

The Western Cape Provincial traffic department has created a very dangerous situation on the N2 between Sir Lowry's and Houw

Hoek passes. Previously, in several sections between those passes the 100 km/h standard speed limit was reduced to 80 km/h, due to dangerous intersections.

Now, two sets of cameras have been installed for average speed enforcement. The old 80 km/h restrictions have been removed and the limit now is 100 km/h all the way between the cameras. Where before it was deemed dangerous to exceed 80 at those intersections, it is now okay to go through them at 100. There is no sense in this, unless the idea is to trap more motorists and thereby earn more revenue.

TONIE VAN ALTENA
GANSBAAI

FROM TRACK TO TRUCK

Why has no large truck manufacturer adopted an energy recovery system similar to the KERS used in F1 cars? The hundreds of "heavies" on the N3 between Joburg and Durban every day must generate a huge amount of energy going downhill. This is all wasted and dissipated as heat through the braking system. If only one tenth of this could be captured, it would give the truck a great boost going up the next hill – and save a large quantity of diesel. Lugging a 500 kg battery along on a 25-ton truck should not be a problem.

Secondly, has anyone constructed a pilot CSP (concentrated solar power) station in South Africa? Surely, with our abundant sunshine and almost zero operating costs, this should be the way to go.

DAVE CANNON
BY EMAIL



SQUARE UP AND RECYCLE

I travel around the country a lot and cannot believe how much trash there is everywhere. A huge amount of this is discarded soft drink bottles. I am sure only a fraction end up being recycled. Perhaps it's time for the soft drink companies to change the design of their bottles to square bottles instead of round.

The first obvious advantage would be storage space. Square bottles make for better use of space for transport. Apart

from this, square bottles filled with sand could be used as bricks and plastered over.

Let's turn something considered as trash into something of value. A campaign of educating people on how to build with these bottles would probably result in an increase in the sale of the products being sold. This could be extended to all types of plastic bottles, including milk. The shape could be designed to interlock.

GRAHAM
BY EMAIL

(Pictured above is a classroom built from recycled bottles, as featured in PM April 2015 – Editor)

CORDLESS DRILL BATTERY A WEAK POINT

I read the article on the anatomy of the cordless drill with interest. It seems that the battery pack is probably the largest part of the device and the motor actually quite small.

I have owned many cordless drill drivers and the battery always seems to be a problem. (These are obviously DIY models, not the industrial category.) The battery gives up at the wrong moment, or is flat after a period of standing.

From what I have read, keeping your batteries charged all the time, even when not in use, prolongs their life. However, this is impractical if you usually use your tool every few weeks or few months.

There is a lot of research in regenerative charge from devices or motors. The effect is similar to how regenerative braking charges the electric car battery and also, in a way, how the alternator charges a normal car battery. What's the possibility of having a regenerative drill driver? The rotation and start-stop action of the motor could create a regenerative charge that recharges the battery. It would be almost like connecting a miniature alternator to the drill motor. In this way, the battery remains charged while in use. If there is a period where you are not using the tool, you can charge it normally via the power outlet. How cool would that be?

RUPESH DAYA
RONDEBOSCH

VOLTAGE ERROR

Sharp-eyed readers have pointed out that, in *Beat the Blackout* (July 2015, page 34) our diagram shows two batteries in parallel with a 24-volt input voltage indicated. The correct voltage in this case is in fact 12 volts.

Part 6 of our 10-part series Motorsport Technology Down the Ages

Where legends are born

Motor racing at its most basic is pretty uncomplicated: as any informal – and usually illegal – street drag racer will tell you, all you need is a couple of cars and something that could pass for a roadway. So, in the early days, anything from public roads to suitable open space formed the basis for race circuits. But it didn't take long for enthusiasts to recognise that dedicated circuits were the way to go. So, back in 1907, the first purpose-built racing circuit, Brooklands in the south of England, came into being.

Initially, pure speed was the driving factor behind race circuit design. That need gave rise

challenging corners and not a little risk.

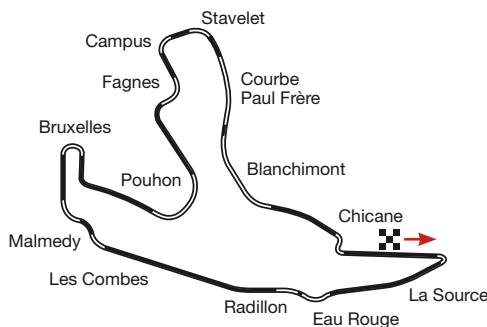
Take Monza, one of only three circuits (along with Monaco and Silverstone) remaining from Formula One's 1950 inauguration. This high-speed ribbon of tar threaded through the woods north of Milan has claimed nearly 90 lives, 52 of them drivers. Albeit with concessions to safety in the form of a couple of chicanes, it's still a track where cars run with minimal downforce, drivers travel flat out for most of the time, and brakes take a fearful hammering. Remember, the fastest ever F1 lap was recorded here.

Sometimes, it's topography and climate that make a circuit out of the ordinary. At Belgium's

Circuits evolved from high-speed banked tracks (Brooklands, left) to dedicated facilities that made use of the local topography to test speed, skill and bravery (Spa, below), with only Monaco (below, left) remaining of the traditional narrow, twisty street venues, largely thanks to its glamorous image.

CIRCUIT DE SPA FRANCORCHAMPS

Circuit: 7,004 km / 4,352 miles
44 laps



to long straights and banking like that of Brooklands and, later, Avus in Germany and Monza in Italy.

In time, circuits were designed to combine elements of all-out straightline performance with those that could, conceivably, be regarded as related to driving on normal public roads. In fact, some of those circuits incorporated public roads – and arguably the most notable is Monaco. The principality's circuit on the city streets of Monte Carlo and La Condamine has remained largely unchanged since its first use in 1929. Old-fashioned, demanding, slow and with little margin for error, Monaco is an unlikely survivor in the modern era largely thanks to its glamorous image.

But, as top-flight motor racing became more global and commercialised, many other legendary circuits have not survived. Older circuits tested car and driver with long lap distances,

Spa, for instance, elevation changes and variable weather keep drivers wary. And sometimes skill is not enough: you need bravery, too, to dominate the likes of the breathtaking right-left-right Eau Rouge or the testing La Source hairpin.

Which seems all so anachronistic when compared with the current generation of tracks. Instead of top-end speed, it's about brief spurts of fierce acceleration, equally fierce braking, rapid changes in direction and – importantly – vastly improved safety. In fact, any of today's circuits have been designed by one man, Hermann Tilke.

Unfortunately, in the view of many traditionalists, these developments have sapped the character of many circuits and resulted in newer layouts that seem rather too similar in feel. But, given the sport's turbulent history and frequent shifts in power, don't expect that we have heard the last word on this subject...

WORLD RENOWNED FINISH



RICHELIEU.CO.ZA [WWW.FACEBOOK.COM/RICHELIEUBRANDY](https://www.facebook.com/RICHELIEUBRANDY)

Not for Sale to Persons Under the Age of 18.

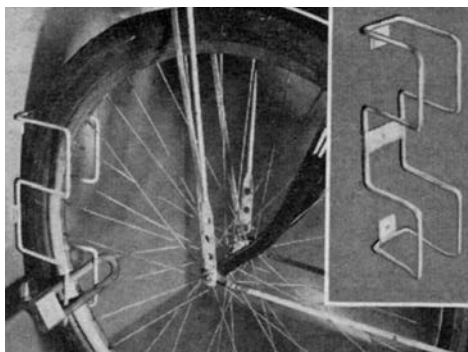
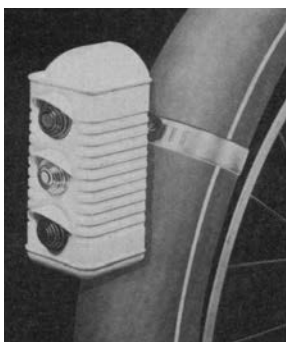
Our feature **Sweat Ethic** (page 50) focuses on bikes, the science of fitness and the technology of sport, so that guided our trip to the archives this month.

1973 The cover story was compiled by the doyen of American cycling literature, Eugene A Sloane. (The bike pictured incidentally, is one of the crowning glories of the USA's bike boom, the Schwinn Paramount.) Sloane started cycling rather late, in middle age, as a way of getting fit. That got the former public relations exec into writing, starting with the legendary *Complete Book of Bicycling*.



1954

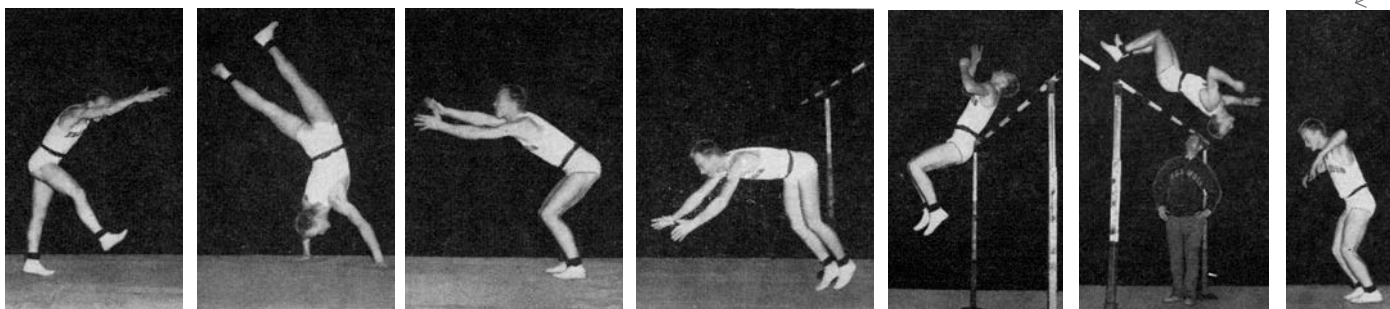
Motorists behind were given due warning of a cyclist's actions by the red, amber and green signals from this miniature battery-operated traffic light mounted on a bike's rear mudguard. Pedalling lit up the green, coasting the amber and braking the red. Given motorists' typical response to amber, perhaps this wasn't such a great idea.



Parking your bicycle neatly was made a lot easier with this wire-frame wall bracket that secured and protected the bike. Consisting of a continuous length of heavy-gauge wire bent to shape and welded to rust-resistant metal plates, it bolted to a wall with three screws. A padlock completed the story.

Two decades before Bob Fosbury revolutionised high jumping, gymnast Dickie Browning soared 11 centimetres above the existing world record to clear 2,18 metres. He used a novel technique that involved a running forward handspring, a round-off and a backward double somersault. Sadly, this didn't comply with the athletics rule requiring a single-footed take-off. Browning did subsequently reach greater heights – as a pilot, first for the US Navy and later for 25 years with American Airlines. To think we might all have been trying to perfect the Browning Backflip instead of the Fosbury Flop.

PM



WIN one of five DREMEL product hampers worth R5 849 each



Take your home workshop to the next level with the three smart, versatile and ergonomic tools contained in each hamper:

Dremel 4000 Platinum kit

The Dremel 4000 Platinum Edition is the ultimate Dremel multitool kit. In addition to the top-of-the-line Dremel 4000 with EZ Twist Nose Cap, you get six useful attachments and 128 genuine Dremel accessories, all packed in a high-quality aluminium tool case. Even the most demanding craftsman will be satisfied with this supreme kit.

Dremel MM40

The Dremel Multi-Max MM40 is one of the best-performing oscillating tools with Quick Lock, a quick and keyless accessory change mechanism. Equipped with electronic feedback and soft start, this best-in-class oscillating multi-tool can comfortably handle a wide range of applications, including cutting in wood, plastic or metal, sanding wooden or painted surfaces, scraping, grout removal and more.

Dremel TRIO

The Dremel TRIO has a 3-in-1 spiral system that enables you to cut, sand and rout with one versatile, compact and lightweight tool. Its superior ergonomics include a two-position handle and variable speed, which ensures the most optimal rate of working in different materials. With its 360° spiral cutting technology and plunge-cut ability, the tool makes quick and freehand cuts in wood, plastic, drywall, metal and wall tile. What's more, dedicated TRIO sanding and routing accessories and attachments complete your project from start to finish.

TO ENTER, ANSWER THE FOLLOWING QUESTION:

QUESTION: How many useful attachments are included in the Dremel 4000 Platinum kit?

SMS the word **Dremel**, followed by the answer, your name and email address to 32697 (R1,50 per sms; this service does not allow for 8ta numbers). To enter online visit our Web site at www.popularmechanics.co.za. Competition closes 31 August 2015 and winners will be drawn on 07 September 2015.

Competition rules:

1. Entry is open to anyone except employees (and their immediate families) of RamsayMedia.
2. Only one online entry per person. You may enter via SMS as many times as you like (SMS charged at R1,50).
3. Competition runs until 31 August 2015.
4. We will draw the winner(s) on 7 September 2015.
5. The prize is not redeemable for cash.
6. Prizes not claimed within 3 months will be forfeited.
7. The judges' decision is final and no correspondence will be entered into.
8. Regrettably, only South African residents are eligible for prizes.
9. By entering this competition, you agree to receive future correspondence from POPULAR MECHANICS. You can opt out at any stage by: (a) Sending an e-mail containing the relevant details with the subject line "opt out" to pmmailers@ramsaymedia.co.za; or (b) Sending an SMS including the word "STOP" to 31699. Standard SMS rates apply.



<https://www.facebook.com/pages/Dremel-Southern-Africa>

https://twitter.com/Dremel_SA

Popular Mechanics
BE THE FIRST TO KNOW



HOW YOUR WORLD WORKS

WEARABLES ► SHARK CAM ► MIND TRANSFER ► WRIGHT BROTHERS ► ART

SPECIAL REPORT | WEARABLES

WEARABLES: STUPID OR AMAZING?

Nearly every sport has a new device to attach to your glove, cap, shoes or racquet. They all claim to improve your game. We took a look at two of the most promising to find out if they can really help.

THE FIRST TIME I SWUNG A TENNIS RACQUET, the ball got stuck in the V of the handle, and I got humiliated. More recently I lined up a sure backhand winner only to send it out of the court and into the windscreen of a passing car. I like tennis, but clearly finesse eludes me. So I was eager to try Sony's new Smart Tennis Sensor, a device the size and weight of a large acorn that snaps into the bottom of your racquet and records data as you hit, then sends everything to a smartphone app for analysis – and a chance to improve.

To set it up, you remove the racket's end cap (currently Head, Prince, Wilson, and Yonex make compatible rackets), install a bracket in its place, then snap the sensor in. Your phone connects to it over Bluetooth. By measuring the vibrations generated by each shot, the sensor determines

► A COACH IN YOUR RACKET

Sony's sensor is the backseat driver of tennis, tracking and analyzing every shot. If you let it.



where on the racquet head you contacted the ball and distinguishes eight different types of shots – including backhands, forehands, volleys, smashes, and serves – while capturing swing speed, ball speed and spin.

I tried the sensor on a Wilson Blade 98S, a light, quick racquet that I unnecessarily worried would be out of balance with the sensor attached. Over the hour during which my opponent and I took turns using the racket, his backhands seemed more effective than mine. Sure enough, when we isolated backhands on the app, his were far more consistent in speed and placement. (But I had more topspin.) You can also use the app's video feature to record your game. It automatically syncs the footage with each shot, so if you want to look at all of your dominant topspin forehands, you can. Generating a supercut of one type of shot is as simple as checking a box.

To find out what experienced players thought, I asked Sidd Thangirala and CJ Leong, of the New York University Men's Tennis

team, to try it. They found the sensor a bit obtrusive. Unlike novices, who hold the racquet high for greater control, advanced tennis players hold their rackets far down on the handle in order to generate more power, which meant both guys could feel the sensor jutting into their palms. On two-hander shots, Leong even managed to knock it out of the racket.

Clearly the device is better suited to beginning to mid-level players: pretty much anyone interested enough to take lessons. And that makes sense. The gap between the best university-level players isn't big. It requires an expert coach to navigate it. The gap between the baseline and a speeding windscreen? An app can work wonders. – KEVIN DUPZYK

► THE ROBO GOLFER

In golf there are mechanical players and feel players. I'm one of the latter. When I swing, I don't fight through a flurry of technical steps. I wait for the gentle tug at impact to tell me I've found the sweet spot, as if I were hitting a marshmallow. In my 20 years of playing, I've clung to the belief that overthinking strangles the fun out of the game. But with so many new swing-analysis gadgets being introduced, I finally gave in to curiosity.

Zepp measures and records your swing through a small sensor that clips to the back of your glove and connects to a smartphone app. Input your age, height, grip style, and the make and model of your clubs, and after each swing you'll see a score and a 3D animation. The readout also shows your ideal club plane, swing speed, backswing versus downswing tempo, and hip rotation. Unfortunately it can't account for ball flight or the

important factor of head movement.

A few of my better shots received scores in the 80s. Some swings that registered in the low 90s, however, produced mediocre shots. This is not to say that the measurements were inaccurate, just that Zepp score and shot quality don't always correlate with my swing, which I don't bring back as far as would be ideal in the interest of accuracy. Zepp is probably more useful for very good players trying to improve minor aspects of their swing or for beginners whose habits aren't fully ingrained.

For any player the most useful aspect of Zepp is its record keeping. Along with weekly digests telling you how you rank against others, the app produces swing charts that can be shared, or kept to yourself if you don't want to lose Twitter followers. Each swing path can be compared with that of pro players whose swings all score perfect 95s. (For now the app includes Brendan Steele, Ryan



Winther and Keegan Bradley, all young and slim, leaving portly players such as me longing for the addition of a Craig Stadler.) While it's fun to compare yourself with them, Zepp offers a narrow range of shots for the pros, all at full power. I'd be more interested in seeing how a pro gets out of a bunker with a difficult lie, and then practising that.

Even so, Zepp did help my game, mostly because it brought my experiences at the range home. Hours of practice were turned into a series of charts and images to obsess over. I watched my swings over and over. And although I am still a feel golfer, at one point, about a month after I started using Zepp, I startled myself when a little voice inside my head said "hand plane!" on the downswing. Wouldn't you know, it turned out to be a great shot. – PAUL DEVLIN

+ The counterpoint

By **Nick Bollettieri**, legendary tennis coach of players including Andre Agassi, Maria Sharapova, Jim Courier, and the Williams sisters.

"I'm not interested in all the data you can give me. I'm not saying it won't be helpful to track what you're doing in practice, because they say what you do in practice will overflow into actual combat, but training is a lot different. There's no pressure on you. "You can get too goddamn scientific: dip, shoulders turn, do this, do that. It's all bullshit. Just hit the goddamn ball."

HOW YOUR
WORLD **WORKS**

THE SHARK CAM

If you want to see one of the ocean's fastest predators in action, just attach a camera to its fin. Simple, right? BY ANDREW DEL-COLLE

SMAKO SHARKS DON'T MAKE THINGS EASY on scientists. They're pelagic, for one thing, which means they live in the open sea. And they're fast. Faster than any other shark, believed to hit burst speeds of 100 kilometres per hour. Those factors have kept the mako largely unstudied, so much so that no one had seen live footage of a mako in its natural habitat. Paul Matusheski changed that.

Matusheski is the executive producer of *Monster Mako: Lightning of the Deep*, a show that was due to premiere as part of Discovery Channel's cult phenomenon, *Shark Week* (starting July 5). To capture footage of the makos, he knew he needed a better version of the fin-mounted cam-

era and tracking systems used in the past. He wanted a device with forward and rear-facing video cameras, red LEDs for unobtrusive night recording, a water-flow meter for gauging speed, a GPS tracker, a temperature sensor, an accelerometer and a gyroscope to record position, a computer, and a battery. He also wanted the unit to have a 48-hour recording delay, giving the shark plenty of time to return to its natural behaviour.

To help make the device, named Shark Eye, Matusheski turned to Evan Kovacs, director of underwater photography for USA's Woods Hole Oceanographic Institution. For Kovacs and his team, the biggest challenge was trying to achieve the

complexity of what Matusheski wanted in just two months. It took a few modifications and hacks along the way – the water-flow meter, for instance, is just a repurposed wheeled pedometer from a Jet Ski – but they succeeded.

The next challenge was to find sharks. One of the benefits of the thousands of oil and gas rigs pumping away in the Gulf of Mexico is that they have created a flourishing underwater ecosystem that serves as a shark superhighway. After a mako is captured, the seven-kilogram camera is placed over its dorsal fin, and two cushioned bars are ratcheted down to hug the fin – a more humane and effective alternative to the traditional method of drilling holes through the fin. The process takes 20 minutes, start to finish, before the shark is released. The cameras are waterproof to about 1 000 metres, well beyond the suspected diving range of makos. After the 17-hour batteries are empty, the camera automatically releases and floats to the surface for pickup. It's just like the barrel scene in *Jaws*, only with scientific breakthroughs instead of impending doom.

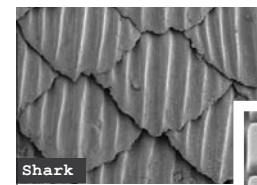
HOW TO SPY ON A MAKO

The Shark Eye system allows scientists to record more and better footage than ever before.

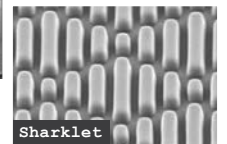
A GoPro sits inside each front and rear camera housing.

The size of the rig required finding makos that were at least 2,4 metres long.

Matuesheski's team attaches a Shark Eye to the fin of a mako in the Gulf of Mexico.



Shark



Sharklet

SHARKSKIN IN THE HOSPITAL

If you ever decide to pet a shark, you'll notice that its skin feels smooth when you move your hand towards the tail, and rough towards the teeth. The scales, called dermal denticles, allow the shark to swim faster – and they might also be a key to preventing hospital infections. Sharklet is a synthetic coating that mimics sharkskin to repel as much as 95 per cent of bacteria. An adhesive film that you can mount to any surface (kitchen counters, handrails, etc.) is already available, but Sharklet's real objective is to protect hospital equipment. The company is currently testing a catheter, an endotracheal tube, and an intraocular lens, each of which is coated to repel the bacteria that cause dangerous complications such as staph infection. Which is not what you're at the hospital to get.



A FEW QUESTIONS ABOUT...

MIND TRANSFER

The futuristic thriller *Self/less* follows a dying man (Ben Kingsley) who pays to have his consciousness transferred into a new body – only to discover that it belonged to an Iraq war veteran (Ryan Reynolds) whose memories now mix with his own. Which is less crazy than it sounds: the idea of transferring consciousness has intrigued scientists for generations, and it may not be science fiction much longer. BY TIM GRIERSON

WAIT. WHAT?

Yep. Really. “It’s definitely going to take a lot of neuroscience and computer science to do,” says Anders Sandberg of the Future of Humanity Institute at the University of Oxford. “But from our perspective, it’s not that crazy.”

HOW WOULD THAT WORK?

It helps to think of a person’s soul as a collection of information, Sandberg says. The challenge is that our brains aren’t as organised as computers. “By mid-century we may have a way to copy information from our brains, but putting it into a biological brain is probably going to be very tough,” he says. “In a computer, you would store the data according to when it arrives.

In the brain, it’s kind of mixed up.”

Memories are created by neurons, and those are connected by synapses. But memories move after they’re formed. As we sleep, events from the day shift to long-term memory. Retrieving them, or even tracking them all down, will prove far trickier than simply double-clicking on a file name.

OKAY, SO 30 YEARS FROM NOW.

Not everybody is as hesitant as Sandberg. Sergio Canavero, director of the Turin Advanced Neuromodulation Group in Italy, plans to conduct a human head transplant in late 2017. He already has a patient: Valery Spiridonov, a 30-year-old Russian who has Werdnig-Hoffmann dis-

ease, a debilitating spinal condition that’s left him confined to a wheelchair.

DOES HE TRANSPLANT JUST THE BRAIN OR THE WHOLE HEAD?

The procedure, which he believes will take thirty-six hours to complete, will fuse Spiridonov’s spinal cord to the spinal cord of a donor body. Though many in his field – and the world in general – find the proposed surgery horrifying, Canavero remains unfazed.

IS THERE ANY CHANCE THE DONOR BODY WILL RETAIN SOME MEMORIES?

Canavero acknowledges that, as in *Self/less*, some crossover between the new consciousness and the old will occur. “The brain filters consciousness, but it also interacts with other parts of the body,” he says, citing research that suggests that memories and other behavioural programs could also be located in the heart and the microbiome. “So there will be an interaction in the new body,” he says. “There is no question about it. There will be interference.”

SHOULDN’T THAT WORRY HIM?

He believes the new consciousness will be able to sift through unwanted leftover memories.

HOW?

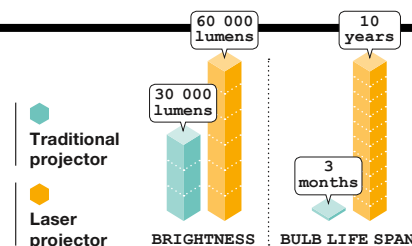
“The self – what you believe you are – can be easily adjusted,” Canavero says. “It’s very flexible.”

AND PEOPLE ARE REALLY GOING TO GO FOR THIS?

According to Canavero, it will require a world power such as China or the US to decide that this type of procedure is a priority. He compares it to the space race (and himself, quite confidently, to JFK). As for the risks, he says, “You have to consider that I am a scientist. I’m curious. I have answers I’m on a quest for. This is going to be huge.” Especially if it works.

HOW TO FIX 3D MOVIES

Merits aside, 3D movies have a problem. They’re way too dim. 3D glasses can block two-thirds of the light output of traditional projectors. The solution? Lasers. Laser digital projectors provide twice the brightness (and use half the energy) of xenon-arc projectors. Up to 4 million individually controlled mirrors direct the lasers, creating an image of unparalleled quality, colour accuracy and brightness. Currently, only a few cinemas in the US (including Paul Allen’s Cinerama in Seattle) have laser projectors but IMAX plans a countrywide rollout soon. In time for *Star Wars VII*, we hope.



HOW YOUR
WORLD **WORKS**

THE ORIGINAL AIRMEN

For his new book, *The Wright Brothers*, Pulitzer Prize winner David McCullough pored over newspaper articles, photographs and more than 1 000 letters to create a gripping account of Wilbur and Orville's quest to fly. He spoke to us about the brothers' training, innovation and post-parade habits.

BY MATT GOULET

POPULAR MECHANICS: No one paid attention to the Wright brothers when they first started working on their aeroplane. Why do you think that was?

DAVID MCCULLOUGH: The fact that they were so ignored is astonishing. Ignored by the press, by serious scientific magazines, by the government, and by the newspapers right in their hometown of Dayton, Ohio. Nobody even bothered to go out and take a look. They did it all themselves. They didn't have any foundation backing them. They didn't have the facilities of some institution or corporation. They didn't have political contacts, or an angel funding their experiments. They

were paying for it out of their own relatively meagre earnings from a bicycle shop, and giving up a hell of a lot in life in order to do it. They were determined to succeed, and they did.

PM: Did their success change them?

DM: There was a huge homecoming in Dayton, celebrating their worldwide fame. For two days there were speeches and concerts and parades. And at every opportunity they quietly stepped away and went to

their shop. I think that's about as revealing of the kind of people they were as almost anything else that happens.

PM: So were they nerds?

DM: It's clear in the records that a great many people thought they were crackpots. Everybody loved to make fun of them. And that doesn't seem to have ever bothered them.

PM: You mention in the book that, after the Wrights were successful, even the Smithsonian was reluctant to give them the credit they deserved. Why was that?

DM: Out of pride in Samuel Langley*. The Smithsonian didn't want to give up on him as the first hero of flight. But eventually they came around.

PM: Were there other things the Wrights didn't get credit for?

DM: The propellers are a very big one, along with their original wing-warping system and their use of a wind tunnel. And nobody had ever built a motor out of aluminium before. Nobody had thought of it.

PM: And all of that was with no formal training?

DM: They hadn't gone to MIT, but they were brilliant. Wilbur was a genius. His letters and speeches were as good as anything being said by anyone. Take his speech before the aerial club in Paris. He

stood up there in front of these learned, sophisticated people and gave a speech, which he wrote himself, as good as could be written by any speechwriter at the White House. Better, actually. And here he's supposedly just a mechanic from a bicycle shop in Ohio.

PM: So much of the Wrights' correspondence informed the narrative of your book. When you think about the way we communicate today, as a historian, are you concerned about how we're going to be able to preserve these things for future generations?

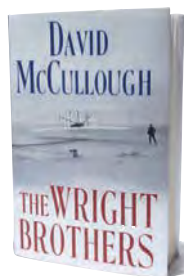
DM: Nobody writes letters anymore. When they do write something, they write it in a kind of pidgin English on electronic devices. And we don't keep diaries. No one in public life would dare keep a diary anymore because it can be subpoenaed and used against you in court. On top of all of that, there's a concern about how long the electronic correspondence will last. There is a whole group of people at the Library of Congress currently worrying about this.

PM: Do you think we have a proper respect for the Wright brothers now?

DM: The usual picture of them is of a couple of bicycle mechanics from small-town America who got lucky and built an aeroplane. They didn't just get lucky. They realised that success didn't mean just creating a flying machine. You have to know how to fly it. Before the Wrights, it was all theory.



ISTOCK PHOTO/PGIAM



FAMOUS BEARERS OF WINGS



Airplanes



Birds

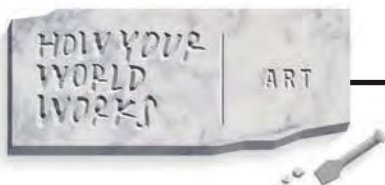


Angels



Hooters Waitresses

* In 1898, the Smithsonian contributed another \$20 000 (about R240 000 in today's money) to a \$50 000 War Department grant Langley received to build a piloted airplane called an aerodrome. The aerodrome crashed twice upon takeoff before the project was abandoned.



HOW TO IDENTIFY A MICHELANGELO

Hint: Check the belly button.

MICHELANGELO COULD HAVE SAVED a team of experts a lot of time if he'd signed his work. Instead, earlier this year in England, those experts spent months studying two bronze statues of men riding panthers. The works were previously credited to a 16th-century Dutch sculptor, but last year a Cambridge University professor discovered a drawing of a similar panther and rider by one of

Michelangelo's apprentices, which would indicate that he used one of his master's works as a model. It seemed like more than just coincidence, and upon further investigation, enough evidence was found to make a compelling case that the statues had been

done by the most famous ceiling painter ever to live. That conclusion was due to be defended at a conference on 6 July. In case you want to judge for yourself, the sculptures are on display at the Fitzwilliam Museum in Cambridge, England until 9 August. We asked one of the investigators, Dr Peter Abrahams, professor of clinical anatomy at the University of Warwick Medical School and coauthor of McMinn's & Abrahams' *Clinical Atlas of Human Anatomy*, Seventh Edition (which is way better than the first six), to walk us through the identifying details.

— SARAH Z WEXLER

THE WISDOM OF MICHELANGELO

"He who is not able to work well for himself cannot make good use of the works of others."

MUSCULATURE, PART I

"The triangle of auscultation. It's difficult to see, because you can't just flex it. Its existence here proves that, even if the sculptor used strong stonemasons for models, he must have dissected a body, since there were no anatomy textbooks at the time. Michelangelo had been doing dissections since he was 18."

NAVEL

"Many artists of the time rendered the belly button in their own distinctive way. Michelangelo's David has a skin hood over the top part of the belly button, and so do these statues."

NETHER REGION

"Few statues of the time have anatomically correct pubic hair. Most sculptors did the classical Greek style for males, which is cut off across the top to make an inverted triangle, that is, female distribution. It should trail up towards the belly button. It's done correctly here, as with the David."

MUSCULATURE, PART II

"The sartorius, the band of muscle going diagonally across the thigh, does not actually contract in the position the man is in, yet Michelangelo would've known it was there from his dissections. Of the 30 to 40 muscles made visible here, nearly all of them are anatomically perfect."

TENDONS

"The peroneal tendon and the transverse arch of the foot are visible, though they wouldn't be bulging in this pose. The only artists at that time who really knew anatomy were Albrecht Dürer, Leonardo da Vinci and Michelangelo. Michelangelo was the only one of them who did bronzes."



AN APPRECIATION: POST OFFICE HANDWRITING RECOGNITION

The US Postal Service processes one billion letters, magazines and envelopes a month. And no matter the variety of chicken to scratch out the address, nearly all eventually get to their destination. How? An Optical Character Reader takes a snapshot of every address, picks out the city, state, street and house number, then compares those against a database to match the address with the post code. Ninety-seven per cent are read automatically. The other 3 per cent get a fluorescent tag and are sent to a plant in Utah to be examined by an actual person with what must be incredible patience. — EBEN WRAGGE-KELLER

PM



When was the first midair refuelling of an aircraft, and whose idea was it?

AS FOR PRECISELY WHO came up with the idea for midair refuelling, that's lost to history, but one suspects it might have been the first guy who ever crashed his aero-



plane because he ran out of fuel. The drive to actually develop the capability arose out of frustrations during World War I.

The first documented midair refuelling occurred on 27 June 1923, when a DH-4B biplane flown out of Rockwell Field in San Diego by US Army Air Service Lieutenants Virgil Hine and Frank W Seifert successfully dispatched petrol through a hose to another DH-4B, this one crewed by Lieutenants Lowell H Smith and John P Richter. Previous attempts at the feat, while creative, were more stunts than practical methods for midair refuelling. One naval aviator took a stab at it in 1921, dangling a grappling hook to snag a 20-litre fuel can floating in Washington DC's Potomac River. In another early attempt, a wing walker strapped a jerrycan to his back and delivered the fuel between planes "on foot".

We've come a long way since. Today military jets generally use one of two air-to-air refuelling methods. There's the so-called hose-and-drogue, which is not, in fact, the name of an olde English pub (though it should be) but rather a refuelling system in which an operator on board a tanker spools out a hose equipped with a mini parachute, into which the pilot of the refuelling jet flies a probe mounted on the aircraft. In the more efficient flying-boom method, the roles are essentially reversed, with the tanker's operator extending a rigid boom and manoeuvring it into a receptacle on the fuel-hungry jet. These fuel booms can deliver as much as 4 500 litres a minute, which is more fuel than most people burn in their car in a year.

{Q} Where did we come from?

{A} Ask your mother.



How is a car's zero-to-100 time measured? Could I get the same number on my own by flooring it?

THERE IS AS MUCH ART AS SCIENCE in coming up with a new car's acceleration specs, which is a fancy way of saying that carmakers introduce a healthy fudge factor to the numbers, designed to take into account, among other things, the data they think car-magazine testers will report, as well as the times they think consumers will actually achieve. In theory, the zero-to-100 time you post shouldn't vary much from the published number.

Though there are alternative testing methods – like the lesser known Thelma & Louise protocol, in which cars are pushed over cliffs and tracked with radar guns as they accelerate towards terminal velocity – in practice, manufacturers don't sponsor a single pedal-to-the-metal sprint to determine a car's zero-to-100 time. Rather, using GPS and other technology, they collect data on acceleration during many test-track outings, in different atmospheric conditions, at different altitudes, with different drivers, etc. These numbers, once suitably crunched, render something resembling an average. Carmakers then publish a time slightly slower than this average, in a nod to the “underpromise, overdeliver” maxim.

{Q} Why are we here?

{A} Ask your father.

Why do we bite the inside of our cheeks now and then? Isn't the human body a refined enough machine to not do that?

» THE HUMAN BODY A REFINED MACHINE?

Please. We're talking about a contraption that sneezes, farts, belches, hiccups, itches, swells, shivers, bleeds and, if certain disclaimers are to be believed, may arbitrarily incur “an erection lasting more than four hours”. Doesn't sound too refined to us. In fact, it sounds like a mechanism eminently capable of injuring its occupant with random acts of intraoral aggression, which it is.

Here's why: first, you may have screwed-up teeth. Perhaps your mouth is too crowded, littered with extraneous wisdom teeth and the like. Maybe your teeth are just plain crooked. Or maybe you've got a bum set of dentures. Alternatively, you may suffer from a mental disorder (other than those you already know about). Cheek biting can be a feature of something called body-focused repetitive behaviour disorder, a type of obsessive-compulsive behaviour.

Most likely, though, this phenomenon is the result of an occasional glitch in our neural circuitry. Activities such as chewing, swallow-

ing, and breathing are hardwired into our brains – we don't need to acquire these abilities, we're born with them.

There are times, however, when our mouths move in ways that are not the result of their factory defaults. Speech is a prime example. It can't be coded into our brains from birth, because we pick up one or more languages over time, requiring us to learn mouth movements to produce new sounds. Occasionally our mouth's hardwired instruction set and its learned behaviours will come into conflict. When they do, unfortunate things – such as biting our cheek, lip or tongue – may result. These conscious/subconscious collisions might occur when we're talking and eating, or when we snack on something spicy that prompts us to move our tongue out of the line of fire. Indeed, research suggests that animals (who don't talk – no matter what Walt Disney would have you believe) almost never bite their tongues, lending further credence to your mother's admonishments to swallow before you speak. **PM**



GREAT STUFF



HUAWEI TALKBAND B1

Get fit and communicate

Wearable fitness trackers that monitor activity levels, calories burnt, sleep patterns and the like are nothing new. Huawei's Talkband B1 goes further, though, by adding Bluetooth 4.1 and NFC connectivity. This allows you to not only pair it with your smartphone to download and manage captured data, but also to take and make calls using a headset. Its modest 90-mAh battery provides enough juice for around six days of regular use, seven hours of talk time and 14 days on standby. It also comes with an IP57 waterproof rating and is dust-protected. Price: about R1 600. Contact distributors DCC on 011 201 8927 or visit www.drivecon.net





THULE LEGEND FOR GOPRO

Safe and secure

Based on feedback from professional athletes and GoPro users, Thule developed the Legend protective case. The Advanced Case (price: about R1 200) can stash up to two GoPro cameras, Flex clamp, 3-way, Gooseneck, LCD backpacks, remote control, extra batteries and SD cards in the crushproof, padded compartment. The smaller Case (price: about: R800) carries one GoPro camera plus the LCD backpack, remote control, extra batteries and SD cards.

Inside both cases removable die-cut foam organiser units keep the cameras and accessories firmly in place. Plus the integrated quick-grip collapsible handle attaches easily to a belt, harness or pack with a carabiner. Contact Thule SA on 0861 184 853 or visit www.thule.com/za



LUKAS LK-7200 FULL-HD CAR BLACKBOX DVR RECORDER

Record your drive

Safety- and security-conscious drivers are wising up to the benefits of dashcams and car DVRs such as the Lukas LK-7200 Full-HD Car Black-box DVR Recorder. Besides being able to record manually or in three-minute loops continuously, it has smart recording ability thanks to a built-in G sensor. In the event of a sudden change of direction or impact, it will save a 30-second recording – 10 seconds before and 20 seconds after. A built-in

GPS module ensures that co-ordinates and speed are recorded to the SD card (8 GB supplied).

Resolution is 1080P Full HD at 30 fps, optimised for a 16:9 ratio widescreen. Plus, the Samsung 2,1 MP sensor has a sensitivity of just 1 Lux, making it suitable for capturing footage at night. Price: about R3 000. Contact Mantality on 011 462 5482 or visit www.mantality.co.za



GARMIN NUVICAM LMT ▲

More than just a GPS

Boasting a built-in dashcam and advanced alerts to enhance driver awareness on the road, Garmin's all-new nuviCam LMT could very well redefine the highly congested PND (personal navigation device) market. Its camera continuously records to the included 4 GB microSD card and, in the event of an accident, Incident Detection software automatically saves files on impact. A Snapshot feature allows drivers to capture still images in or outside the vehicle. And it's more than just a camera: forward collision and lane departure warnings, normally found only on luxury vehicles, are included. Plus, Garmin's Real Vision takes the guesswork out of deciphering hard-to-see house numbers by displaying a bright yellow augmented reality arrow to direct you when approaching select destinations. Connectivity includes voice-activated navigation, Bluetooth and a smartphone link that can provide real-time data services such as Garmin Traffic or safety cameras. Free lifetime map updates and a magnetic mount are part of the deal. Price: about R5 000. Contact Garmin on 011 251 9999 or visit www.garmin.co.za



LIFESTRAW MISSION

Thirst quencher

Originally introduced in 2005 as an easy-to-use emergency response tool for disaster-hit areas, LifeStraw's drinking water filtration technology is thoroughly proven. Fill the Mission's wide-mouth reservoir from a puddle, stream or river, fold the top to seal it and then hang it from, say, a sturdy tree. Gravity then forces the dirty water through an advanced 0,02 micron ultrafiltration membrane, which removes most viruses, bacteria and protozoa. You can expect a flow rate of between 9 and 12 litres per hour, depending on the water quality, and 18 000 litres of pure drinking water during its lifetime. The Mission weighs 430 grams and is supplied in a drawstring stuff-sack. It's available in 5- or 12-litre capacity; expect to pay between R1 400 and R1 600. Contact distributors Aqua for Life on 074 383 0001 or visit www.aqua4life.net



▲ SKULLCANDY AIR RAID

Bring on some noise

Thanks to an impact-resistant silicone outer shell and weatherproof design, Skullcandy's Air Raid Bluetooth portable speaker is designed to stand up to hard-partying users, splashes or drops from up to 2 metres. But sound quality hasn't been entirely neglected: its two 50 mm drivers deliver a maximum of 88 decibels. (To get the best sound, place the unit on its back with speakers facing up.) For non-Bluetooth devices there's a 3,5 mm jack. Recharged by via a microUSB port, it's said to be good for up to 14 hours of music at moderate volume and about 5 hours when you're having an absolute blast. Price: about R2 000. Visit www.luksbrands.com

RAZER KRAKEN PRO HEADSET

Game on

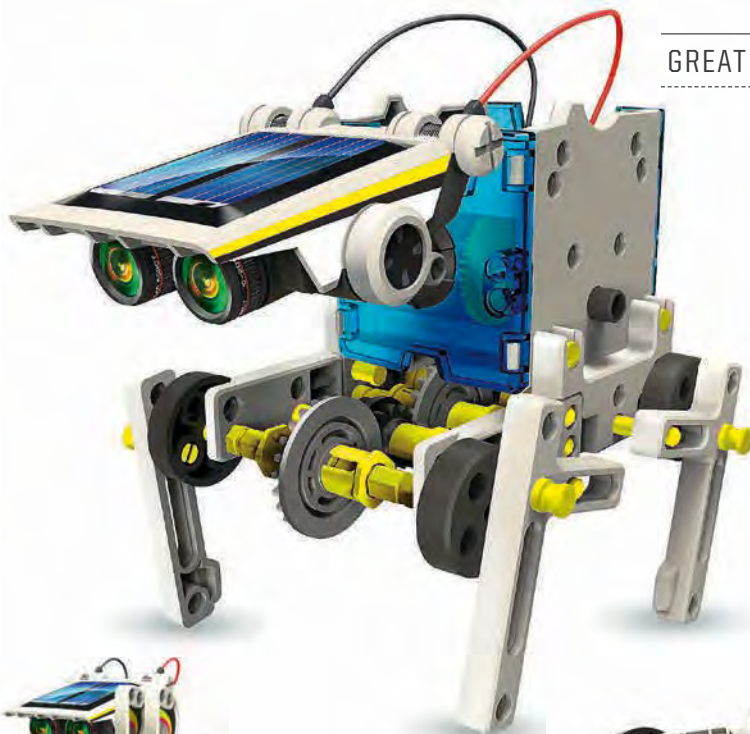
Razer has a reputation for making great gaming gear and its new Kraken Pro headset is no exception. Optimised for extended wear, it has a comfy closed ear cup design with plush padding to keep outside distractions at bay, as well as in-line remote and flexible, fully retractable microphone boom. The beefy 40 mm neodymium magnet drivers are tuned for wide-range audio, combining clear high- and mid-ranges with powerful lows. Price: about R1 200 for standard colours (black, white and green) and about R1 300 for the neon range. Contact distributors Corex on 011 700 7188 or visit www.razerzone.com



14 IN 1 SOLAR ROBOT KIT

Build for the future

In time, today's young minds will be wrestling with finding solutions for tomorrow's energy problems, so there's every reason to encourage youthful tinkerers to become familiar with the basic concepts while they play. Full of accessories and parts, the Solar Robot Kit, suitable for ages 10 and up, can create 14 different designs that include a multitude of comical and functional movements. Two levels allow children to become familiar with the simpler designs before progressing to the more complex. Price: about R310. Contact Yuppie Gadgets on 021 593 5511 or visit www.yuppiegadgets.com



TRACKMIO PERSONAL GPS TRACKER ▲

Track what's yours

If you care about it, there's a good chance that Trackmio can help you track it in real time – whether "it" is a disobedient pet, your wayward teenager, a stolen car or that valuable shipment you sent to Canada. It'll also alert you by phone if your child leaves a pre-set safety zone, and features an SOS button in case of emergency. Measuring 47 mm x 40 mm x 17 mm and weighing just 42 g, it has a GPS that uses the GSM network (SIM card included) to track its location anywhere in the world, to an accuracy of about 15 metres. It has a waterproof silicone case, magnetic attachment, lanyard and 600 mAh lithium-ion batteries good for between 48 and 96 hours of operation. Price: about R1 500. Contact Cape Union Mart on 021 464 5800 or visit www.capeunionmart.co.za

CASIO EDIFICE WATCH ▼

Smart timekeeper

Casio's new Edifice ECB-500/510 watch might look like your average traditional masculine timepiece, but don't be fooled. Sophisticated tech, including Bluetooth, bring it up to speed with the modern world. Once connected to your smartphone via the Casio Watch+ app, it makes juggling between time zones a breeze. You can even use your phone to adjust watch settings such as hand positions and alarm times and transfer stopwatch data to your handset to create a log file of up to 100 entries. Plus, if you have mislaid your phone, simply press a button on the watch to set off an audible alarm. Other features include Casio's proven solar power module, water resistance down to 100 metres, screw-down crown, mineral glass, flight mode and full auto calendar. Price: about R7 500. Contact distributors James Ralph on 011 314 8888 or visit www.jamesralph.co.za





BY DAVID HOWARD

PHOTOGRAPH BY J MUCKLE

HOLOGRAM BY ZEBRA IMAGING



Technology that allows people, places
and things to appear in three dimensions is
changing the way the armed forces operate,
the way people elect their leaders, and the way
entertainers – alive and dead – bring us joy.
Meet the people on the front lines of the other virtual reality.



THE DINOSAUR EXPERT

leans forward on a large L-shaped sofa in a room where blackout curtains erase the Beverly Hills sunshine. Two chandeliers gradually dim and after a short silence a velociraptor appears on a stage scarcely half a dozen metres away, stalking back and forth, gliding on springy hind legs, tail whipsawing. You can't hear any thump of footsteps, or anything at all, but still: the thing is not a flat image beamed from a projector, but a creature with depth and heft and teeth. A physical presence.

Luis Chiappe, a balding man with a beard going grey, is the director of the Dinosaur Institute at the Natural History Museum of Los Angeles County, a 102-year-old institution that protects specimens dating back 4.5 billion years and that recently opened a 1 300-square metre exhibition space called Dinosaur Hall. Over the past 20 years he has conducted fieldwork in Mongolia and Kazakhstan and many other places around the world. In the dark he is visible only by the reflection of the velociraptor in his glasses, so it's difficult to gauge his reaction. But he says, quietly, "That is amazing."

After a few moments a man named Alki David appears onstage, assuming a kind of master-of-ceremonies role. He has close-cropped greying hair and a pudgy, impish middle-aged face. The dinosaur dissolves, giving way to a series of celebrities alive and dead. Here is Ray Charles, fingers somersaulting across the keys of a piano, feet stomping. Here's Jimmy Stewart in a fedora. Eventually the lights rise, and David "Nuzzy" Nussbaum, who stands next to the couch through the presentation, asks Chiappe if he'd like to stand next to the dinosaur. Nussbaum is vice-president of sales at Hologram USA, the company that last year began unleashing holograms into the world in various forms and is holding this exhibition for Chiappe today in a bid for his business.

"Sure," Chiappe says.

He climbs to the stage, where the newly

conjured velociraptor begins prowling behind him, but he is immediately disoriented. He can no longer see the creature: the hologram is visible only from the front of the stage. He crab-shuffles uncertainly back and forth. Nussbaum coaches him to watch a monitor stationed to the side that shows the dinosaur, but Chiappe just keeps gazing around.

Nussbaum walks him back down and suggests that the museum could hire Hologram USA to set up a stage like this one to bring T-rexes to life in the Dinosaur Hall. "What's great about this," he says, "is that you could have kids at the museum take pictures with dinosaurs."

Chiappe considers this, but Alki David isn't done. "Bring up the secretaries," he says, grinning, into a two-way radio.

The lights dim again. Onstage appear two blonde women in the midst of what might best be described as the latter stages of a gentlemen's-club-type presentation. An awkward quiet descends as the women writhe through the air. Finally, with mock outrage, David shouts, "Take them off!"

Outside, Chiappe looks dazzled, maybe a little bewildered, as he blinks in the Sun.

1584 An Italian scientist named Giambattista della Porta, inventor of the camera obscura, first describes creating a three-dimensional, Oculus Rift-like effect in a paper titled "How we may see in a chamber things that are not." The viewer enters a darkened space and peers into a looking glass. The staging actually features a second reflective surface inside, set up so that, when it is illuminated, it reflects pictures of statues and furniture in a way that makes the viewer feel as if he were actually inside a room among full-sized objects.

1858 A Liverpool-born engineer named Henry Dircks picks up the concept almost three centuries later after noticing that glass is both transparent and reflective. Through experimentation he finds that, if he props a sheet of plate glass at a 45-degree angle, he can bounce an image off of it that appears to be floating. He names the effect the Dircksian Phantasmagoria and presents

it to the British Association for the Advancement of Science.

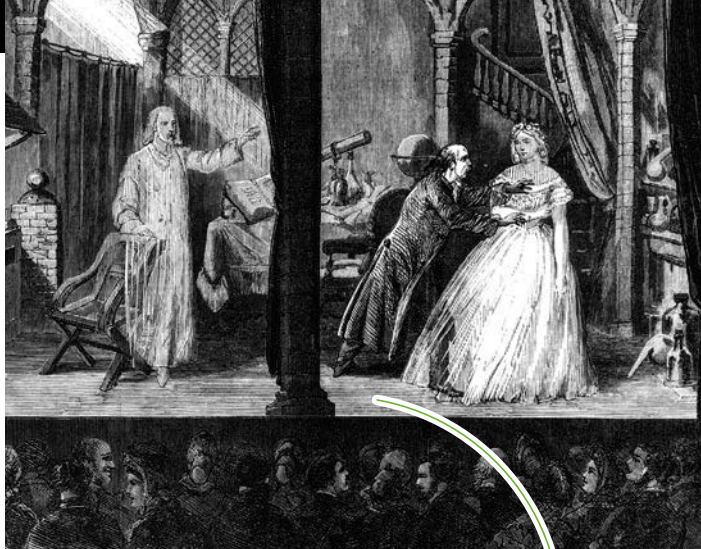
1862 Dircks has no luck selling his effect to theatres, but a scientist and lecturer named John Henry Pepper works out how to modify the set-up for the ghosts in a performance of Dickens's *The Haunted Man*. Although he tries repeatedly to give Dircks credit, "Pepper's ghost" becomes a worldwide sensation, and the name endures to this day.

1969 Pepper's ghost turns up repeatedly at fairgrounds, inside haunted houses, and in magic shows – but hits its pop-culture apex when the Walt Disney Company deploys the effect in the Haunted Mansion ride at the Disneyland theme park in Anaheim, California, where riders see ghosts flying around the Grand Hall.



1977 George Lucas unleashes the first of his *Star Wars* movies, which features actress Carrie Fisher's character Princess Leia as a tiny hologram projected by a quirky droid named R2-D2. It is both a cool trick and a radical vision of the future – suggesting that we might one day drop in on each other in some beamed-in, particles-of-light, there-but-not-there fashion.

1996 Executives at the Ford Motor Company are frustrated by the cost of creating prototypes for concept cars. They wonder: what if they could



study a hologram of a vehicle instead? Ford approaches the MIT Media Lab, where Stephen Benton, who invented the rainbow hologram that appears on most credit cards today, works. The question leads three MIT researchers to form Zebra Imaging in 1996 in Austin, Texas.

Zebra prints 3D files on a polymer sheet that resembles a photographic negative. Each sheet contains hundreds of thousands of hogels – short for “holographic element”. Think of hogels as similar to pixels, only each hogel is actually a single point of view of the image being printed. When light bounces off the polymer, the hogels act as tiny projectors, interfering with the light in a way that makes the image appear to rise off the surface and take on depth and breadth.

1997 German inventor Uwe Maass creates a three-dimensional experience like that in movies, only without the Clark Kent spectacles. “I started wondering, what kind of technology can I use to get rid of the glasses?” he says. He winds up with a 21st-century update on Pepper’s ghost, his stage set featuring a 3D projector and LED lighting – and to replace the glass, a special polymer foil material that’s invisible at a 45-degree angle, but still reflects 60 per cent of the light. The foil is only one millimetre thick, so it can be set up on a scale much larger than any sheet of glass safely could be, and can be easily rolled up and transported too. He debuts the set-up, which he names Eyeliner, for an event by jewellery company Swarovski in Austria that features flying crystals. (See “The Resurrection Machine” for how it works.)

2006 The United States Army becomes Zebra Imaging’s primary customer. The Army orders a new kind of map – 60- x 90-centimetre sheets that troops in the field can unroll and shine a torch on to reveal a hologram of the terrain in front of them. The map allows them to visualise exactly what lies ahead – how steep the topography, where they would be vulnerable to ambush. “Personnel rotated people through very quickly and this helped orient them to the new digs,” says Rick Black, Zebra’s director of government solutions, who during a 26-year Army career helped provide geospatial intelligence support for troops, including the new maps. “They were able to visualise in full 3D what their environment was going to be like.” Troops can also use the maps to consult with locals about where they’re going, and can draw missions on them with dry-erase tools and later wipe them clean.

Multiple studies demonstrate that people process information more easily and understand it more quickly when they see it in three-dimensional form. The Medical Simulation Research Branch of the US Army Research Laboratory published a study involving two groups of medical students that were each presented with materials on the anatomy of the human heart. One set depicted the valves and vascular structures in traditional textbook format; the other showed the heart in holographic form. The students were tested after studying the materials and the ones who had looked at holograms remembered more

connects with Johnny Fratto, a talent manager who frequently appears Howard Stern’s radio show. Fratto arranges a meeting with Alki David at David’s production studio. David instantly loves the hologram technology, but Maass worries that David lacks space for the Eyeliner set-up. Maass “looks around and says, ‘There’s not enough room, you really can’t do anything,’” Fratto says. “So we’re standing there talking, and, I swear on my kids, all of a sudden the goddamn sledgehammer comes through the wall. Alki is on the other side of the wall with a sledgehammer.”



about the heart’s anatomy with less effort.

Zebra Imaging provided more than 14 000 holographic maps to American troops in Iraq and Afghanistan over a decade and during that time the technology improved markedly, according to Zebra marketing manager Eric Doane. By the time the program wound down, the time required to create a map had dropped from five days to 90 minutes.

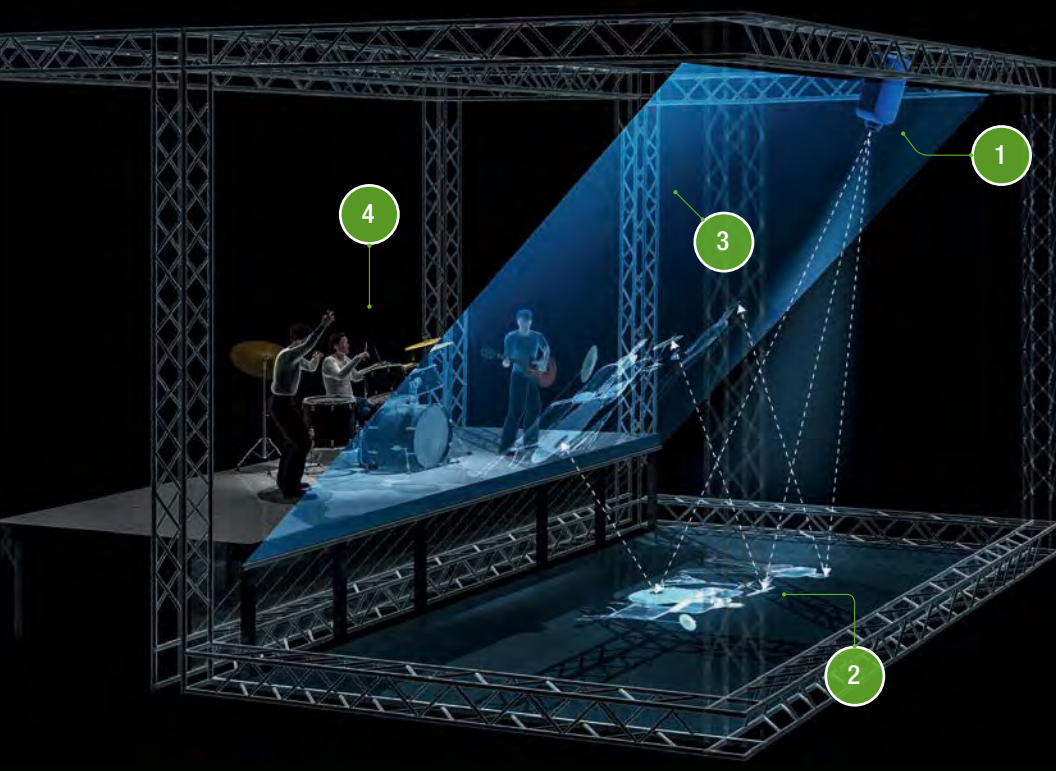
2012 Maass creates a hologram of the late hip-hop artist Tupac Shakur to appear onstage at the Coachella Music Festival with Snoop Dogg and Dr Dre. The illusion is so lifelike that it makes Princess Leia’s hologram seem quaint in its grainy jitteriness. A video of the event generates 15 million YouTube views in 48 hours.

2013 Maass, looking for a business partner in the United States,

Hologram USA is born. “It’s very simple, age-old, snake-oil type of stuff,” David says. “But done with 21st century technology, it’s mind-blowing.” Fratto, who is a partner in Maass’s business, negotiates a piece of the business for himself: Holografixxx will provide holograms for adult entertainment, though Maass says he may curb that kind of use for fear of losing other kinds of business.

2014 Narendra Modi enters the race for prime minister of India. His polling numbers hover at around 34 per cent, not a promising start. He hires Maass’s company, MDH Musion, and begins delivering speeches at as many as a hundred rallies at once by hologram. His three-dimensional doppelgänger speaks in more than 1 400 locations, reaching, by some estimates, 14 million additional voters. “When people got word that he was projecting himself as a hologram to these

THE RESURRECTION MACHINE *A look at the technology and staging that could bring Hillary Clinton to 17 campaign events at the same time.*



Inventor Uwe Maass came up with a modern iteration of Pepper's ghost that creates startlingly real illusions. Here's how it works.

– EBEN WRAGGE-KELLER

1 A high-definition Digital Light Processing projector hangs from the top of the stage set and projects a special 3D video downward in front of the stage.

2 A large reflective surface placed either in the band pit or in another low spot in front of the stage mirrors the image upward.

3 A sheet of polymer-foil material attached to the front and top of the stage and tilted forward at a 45-degree angle catches the image. The foil replaces the glass that was originally used in Pepper's ghost demonstrations – because it's safer and easily transported, and it eliminates shadows that glass throws.

4 The image appears on the stage and, because it is projected in 3D, looks like it has depth, width and height rather than a flat, movie-screen look.

ILLUSTRATION BY BRYAN CHRISTIE

places, he started to generate enormous crowds – 30 000, 40 000 people per location,” says Nussbaum. Modi wins the election, garnering a rare plurality with 53 per cent of the vote and an Indian political observer opines that holograms call to mind “the Hindu mythology, where the God was omnipresent”.

In the United States, holograms begin appearing in unlikely venues. In May, a Michael Jackson hologram performs at the Billboard Music Awards five years after his death. Julian Assange, the WikiLeaks founder who has spent three years in asylum at the Ecuadorian embassy

in London, appears in September in front of nearly 1 000 people in Nantucket, Massachusetts, as a hologram. Sitting on a stool identical to the one his flesh-and-blood host occupies, Assange answers questions from the crowd and attempts, at the end, a hologram-to-human high five.

And in November Jimmy Kimmel hosts his late-night talk show in Los Angeles while simultaneously appearing by hologram at the Country Music Awards in Nashville, Tennessee. “We were aware that the technology was out there because of the cool pop cultural moments that had occurred,” says Doug DeLuca, co-executive producer of *Jimmy Kimmel Live*. Kimmel obviously couldn't be in both places at once, so the hologram “seemed like an innovative and elegant solution”. Nussbaum says Hologram USA is building an installation for *Jimmy Kimmel Live* so the host “can beam people in for interviews at any time”, making him the first major television entertainer to embrace the technology.

2015

David says part of his vision for Hologram USA is that no celebrity ever has to die. The company is working on deals with major theatres – Nussbaum mentions the Apollo in New York City as an example – to create permanent installations. (The Apollo did not reply to an email seeking comment.) He



recently reached agreements with the estates of Ray Charles, Liberace and Buddy Holly, among others, to create live performances. Liberace's estate was the first to sign on for appearances at a Las Vegas site to be announced. “The show will have all the glitz and glamour and razzle-dazzle of a real Liberace show, with the jewels and cars and showgirls,” Nussbaum says. And the show will be interactive – if someone yells out a request, hologram Liberace can (if it's in the preprogrammed database) play it. If someone in the audience is celebrating a birthday, hologram Liberace can – through some technological sleight of hand Nussbaum declined to reveal – invite her onstage, kiss her on the cheek and hand her a bouquet of flowers. “They will be real flowers,” Nussbaum says.

Hologram USA licensed its technology



to Universal for a ride that opens this summer at Universal Studios Hollywood based on the Fast and the Furious movie franchise. "It's the next generation of entertainment," David says. "I've been in the media space and the entertainment space since I left film school, which was in '92, and I've never ever seen anything attract A-list talent the way this does. We've had Al Pacino banging on the door twice in a week to see the technology. We contacted Alicia Keys and said we're doing Ray Charles [resurrected as a hologram]. It was, 'I have to be in it.'" (Keys, who previously appeared with a Sinatra hologram, declined through management to discuss the event. Pacino did not respond to a request for comment.)

Others are finding more potentially meaningful ways to use the technology. A group protesting new laws curbing freedom of speech in Spain faced steep fines for gathering in front of the Parliament – so they took to the streets as holograms. Videos of the ghostly sign-waving crowd torpedoed around the Internet.

In Austin, Texas, Zebra won a bid from DARPA, the US military's research-and-development wing, to create the Urban Photonic Sandtable Display, a full-colour holographic image that can rotate in space. The company has discussed providing holographic maps of desert regions along the US border in Texas and Arizona to Customs and Border Protection agents, Doane says. The country's Federal Emergency Management Agency might eventually use the maps for disaster response.

2016 and beyond Could Narendra Modi's idea be repeated elsewhere, so that a presidential candidate might stump as a hologram in one part of the country while shaking hands in person in another? Maass says a team from Hillary Clinton's campaign visited David's Beverly Hills studio last year and seemed intrigued. "I'm pretty sure she's going to go for it," Maass says. "If Hillary does it and she wins, then it's going to be very easy to have it be seen as a tool." (The Clinton campaign did not respond to a request for comment.)

Maass says he's spoken with national political leaders on several continents. "The use of it in politics is phenomenal," David says. "Whoever embraces it for 2016 will win. We are kingmakers here."

The campaigns are, predictably, more circumspect. Tim Miller, communications director for Jeb Bush, says he has no hologram plans yet but adds: "We are committed as an organisation to leveraging technology, so you never know."

Scott Goodstein, founder and CEO of Revolution Messaging, was the external online director for US president Barack Obama during his 2008 campaign, so he knows something about squeezing votes out of technology-based tools. He says that, based on what happened in India, presidential campaigns might look at the hologram technology – but the high-tech illusion won't be enough to make much difference on its own. "Will holograms get people to pay more attention to a candidate's message?" Goodstein says. "That, to me, is the big question."

Regardless, Maass and David will keep looking for new venues for their hologram experience. Founders of the National Comedy Centre, set to open in August 2016 in Jamestown, New York, Lucille Ball's hometown, didn't want a museum or hall of fame. They wanted a place where people could experience comedy – where

simply be called holograms you can play with. Picture the old science-fiction-movie trope in which a character alters a holographic image hovering in the air with the swipe of a finger. Zebra is working on versions in which someone sitting at a computer could draw a graphic on or otherwise manipulate a 1,2- x 1,8-metre hologram projected on a wall.

Zebra suddenly has a growing roster of competitors – particularly in the realm of medical imaging. Holography is capable of showing patient organs and bones with greater precision and accuracy than conventional two-dimensional imaging tools such as ultrasound – and it could also help doctors pinpoint issues in intricate, multi-faceted organs. A California startup named EchoPixel created a software platform, True 3D Viewer, for use in diagnostics and surgical prep. RealView Imaging generates real-time holograms that can be updated



the world's greatest comedians could come to life, even the dead ones. Chairman Tom Benson says he discovered Hologram USA's Web site. "I thought, I hope it's as good in person as it looks online," he says. "When I saw it and realised what it could mean to us, a lightbulb went off."

The NCC will feature as its cornerstone attraction a virtual comedy club where visitors can watch holograms of iconic comedians such as George Carlin and Rodney Dangerfield perform classic sketches. "It will be an area where people can suspend their disbelief," Benson says, "and experience routines as if they were there."

A Ronald Reagan hologram in his presidential library? That one is in development, Nussbaum says. (The library did not respond to a request for comment.)

Zebra Imaging is working on what Doane calls "real-time collaborative holographic visualisation", but what might

digitally via a stylus. If medical authorities approve it, the device could allow surgeons to generate a hologram of a patient's heart to help them visualise how best to proceed with an operation. Nanolive's 3D Cell Explorer generates stereoscopic images of tissue at the cellular level – a technology that may help researchers better grasp how diseases interact with the body.

Some of the ideas flying around make you feel both the wonder and the consternation that Luis Chiappe felt in the presence of that dinosaur. The technology might be limited only to whatever the imagination can come up with – including extending, in an ephemeral way, our own lives. Nussbaum recently worked with a wealthy industrialist in his nineties to create a hologram that would allow the man to give his own eulogy. But before they could make it happen, the man died, and the eulogizing was left to humans. **PM**

CARS

AMG SPEEDSHIFT MCT

AUTOMATIC FIRE

FINALLY, A RACE-READY PLANETARY TRANSMISSION THAT BRINGS OTHERWORLDLY PERFORMANCE TO THE COMMON MAN.

BY LINDSEY SCHUTTERS

The last thing you want to do when driving a performance car near its dynamic limits is take your hands off the steering wheel. As much as an expert command over the left pedal and stick shifter can stroke the ego, automatic transmission is a much more sensible way to handle torque in excess of 400 N.m. Mercedes-Benz knows this and has been offering variations of the planetary transmission on all of its Mercedes-AMG cars since the 1993 C36. The Speedshift MCT is the finest example to date – on any car. To be honest, the MCT (multi-clutch technology) transmission isn't new. Having first been available on the 2009 SL 63, it's been around a long time.

What sets this autobox apart is a complete abandoning of the torque converter in favour of a compact multi-plate wet clutch for getting off the line. This innovation allows for similar 4 000 r/min race starts as experienced on, say, the Lamborghini Huracán. The crowning achievement, from a Mercedes point of view, however, is that the gearbox weighs in at a miniscule 80 kg thanks to its magnesium casing.

Other things the Merc guys keep raving about are things such as the higher power density (which means it's smaller than the DCT it replaces, while offering no power-train drawbacks) and the small centre tunnel needed to squeeze in the gearbox – a design requirement that Mercedes-Benz takes particular pride in.

We were more concerned about the brains of the car. The AMG Drive Unit com-

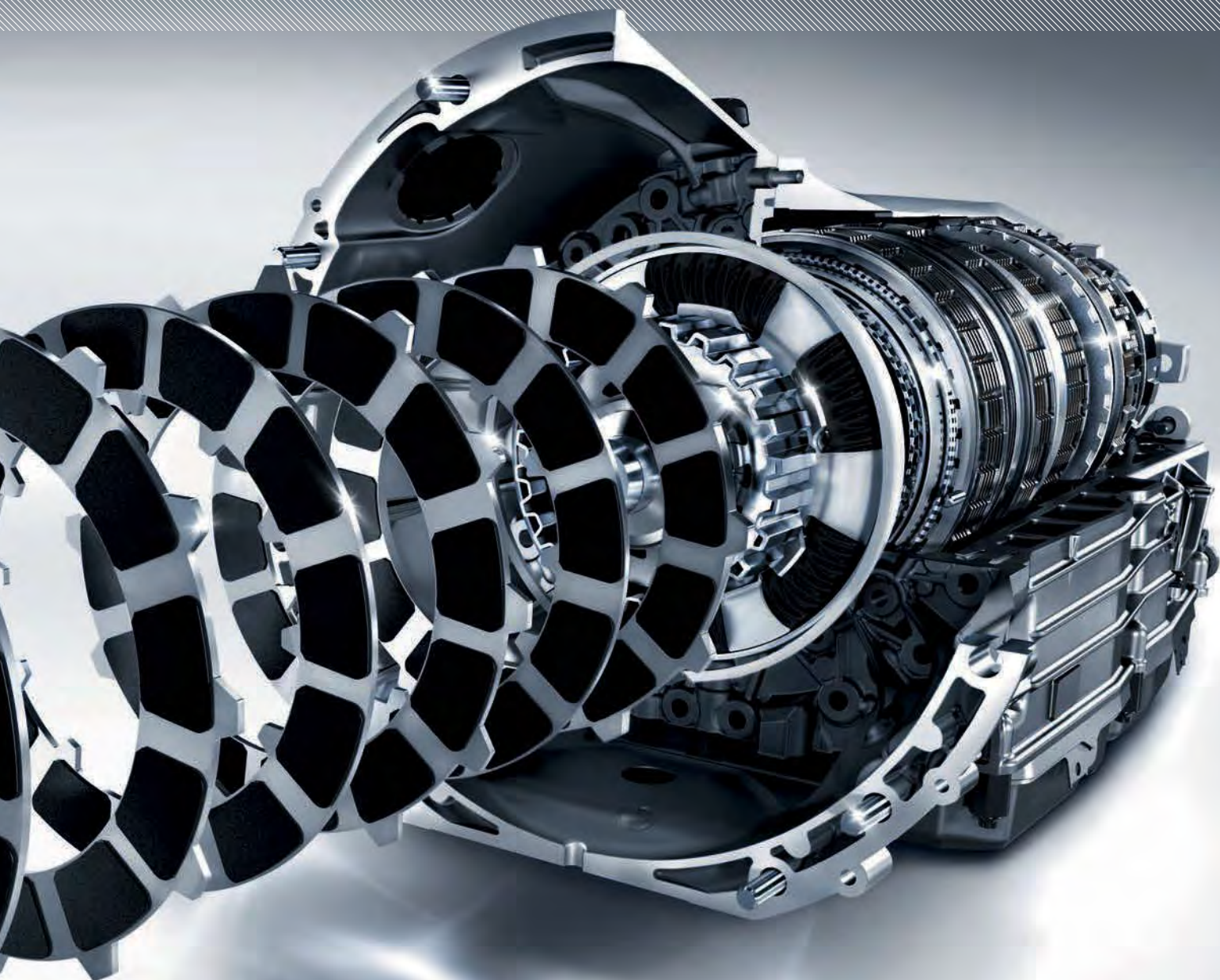
bines all the sensor and control input and adjusts the shift logic according to driving conditions. On the Mercedes-AMG C63 S (note the combined Merc and AMG nomenclature; this means that cars don't get sent to be tuned, but rather cars are developed as a partnership from scratch) you get four driving modes: C, S, S+ and Race.

The C is for Controlled Dynamics and opts for higher gearing to increase fuel

efficiency and limit engine noise. On kick-down, though, the transmission will shift down as many as three ratios to give instant, sporty response.

When you're in the S modes, the transmission performs automatic double declutches and pre-selects the next gear for quick changes (Merc claims as swift as 100 milliseconds), with shift speeds depending on throttle input. You can also





The AMG Drive Unit is mission control for changing between drive modes and altering other dynamic settings; it's the brain behind the thrills.

shift manually via the paddles and get as near as makes no difference to the redline – we did experience a few downshift rejections when the computer decided the engine speed was too high.

Race mode comes with the launch con-

trol ritual that needs synchronised paddles and some foot shuffling. But the squealing race start and being jammed into the seat-back are your reward.

With enough technology built in to make any technophile weep with joy, it

should come as no surprise that the car's radar (the bit that makes active cruise control possible) also feeds into the AMG Drive Unit's thought process. If you go barrelling up behind another car, the radar will alert the system and engage a double downshift according to your braking power to add some torque drag to help you stop sooner. The harder you brake, the earlier the downshift.

It's astonishing that Mercedes has experienced zero failures in testing or in the field with the Speedshift MCT when you consider the type of cars the transmission has been deployed in. And while that streak continues, this can be considered the best automatic transmission on the market today.

MERCEDES-AMG C63 ROLLING THUNDER

I loved the old M156 6,2-litre V8, even with its allegedly dodgy camshafts and valve lifters, and was delighted when it had a last hoorah in the SL63 and C63 AMGs. Those naturally aspirated days are gone now and what we have here is a 4-litre biturbo V8, which, despite all the emissions reductions and fuel efficiency, sounds a bit better than the engine it replaces. There's also no denying the insane 650 or 700 (depending on which version you take) N.m of torque spinning the rear wheels.

And that's kind of the problem. If you spend a million rand on a model of car, you'd expect only one version of that model, surely? Not according to Mercedes-Benz, which lets you choose between a performance-oriented AMG C63 and a more powerful (and R160 000 more expensive) AMG C63 S. That choice detracts from how brilliant the car is and just how much Merc has upped the ante over its competitors.

Engines are produced to the standard AMG "one man, one engine" philosophy and the twin turbo set-up spools up pretty quickly. As you'd expect when there's so much force going through the rear wheels, the car can err on the side of tail-happy, but some electronic wizardry in the standard model – which Merc irritatingly call a diff – keeps everything in check quite nicely (even saving me from disaster at the Zwartkops launch). You get a proper mechanical differential on the "S" to better help corral the extra 25 kW and 50 more torque.

The car accelerates with a forceful assurance, sounds like a bass heavy brass band and is very well balanced in the corners. We had some time on the skidpan, where the turbos were even interfering with the instructor's attempts at controlled sideways chaos.

Other than it being a bit ungovernable in a drift, Mercedes seems to have done enough to carry on the proud C63 heritage. Whether the new car will surpass the 40 000 global sales of its predecessor time will tell, but the launch of a coupé version wouldn't harm the chances. (Hint, hint...) – LS



VITALS:

Mercedes-AMG C63

MAX POWER: 350 kW at 5 500 r/min
MAX TORQUE: 650 N.m at 1 750 r/min
PRICE: R1 004 700

Mercedes-AMG C63 S

MAX POWER: 375 kW at 5 500 r/min
MAX TORQUE: 700 N.m at 1 750 r/min
PRICE: R1 163 800





CHEVROLET EVS POWER TO THE PEOPLE

Four new EVs already this year – the first wave of an electric transport revolution. General Motors is setting itself an ambitious target: to bring electric vehicles to the masses. As evidence, the company points to its 2016 Volt, Malibu Hybrid, FNR Concept and production commitment to the **Bolt EV**.

Building on Chevy's expertise gained from the Volt, the Bolt EV is described as "the game-changing, next-generation all-electric vehicle". It's designed to offer better than 200 miles (320 km) at a target price in the USA of around R360 000.

The Chevrolet-FNR, which made its debut at the 2015 Shanghai Motor Show where it received the Best Leading Technology Award, is a self-driving EV concept designed to meet the transportation needs of the future. It can sense driver biometrics, switch between autonomous and manual driving and even suggest alternative driving routes. The 2016 Volt builds on the original's strengths with an electric-only range of 80 kilometres and a total range of around 650 km. It uses an all-new, second-generation Voltec extended range electric propulsion system. The other car launched this year, the Chev Malibu Hybrid, uses Volt-derived tech to arrive at segment-topping estimated combined fuel economy rating of 5 litres/100 km – unsurpassed in its segment.

The Bolt's features include driver-selectable operating modes designed around preferred driving styles such as daily commuting and spirited weekend cruising.

It's built of **lightweight materials**, including aluminium, magnesium, carbon fibre and woven mesh to help complement the design while cutting weight. There's also a concept Bolt EV Connect app designed to allow a smartphone to perform as the key fob, allow ride-sharing management and incorporate automatic park-and-retrieval technology.



AND, IN OTHER CHEV NEWS...

- The 2016 **Chevrolet Cruze** is powered by General Motors' new global family of Ecotec small-displacement engines, featuring a modular architecture that is easier to build and adaptable to global markets, while offering customers segment-challenging efficiency, refinement and durability. In North America, the Cruze is offered with a new 113 kW Ecotec 1.4L turbocharged engine that features direct injection to help offer a GM-estimated 5,9 litres/100 km on the highway with a new six-speed automatic transmission and standard stop/start technology.

- **Theft Alarm Notification** is a new service, part of GM's existing Stolen Vehicle Assistance service that allows OnStar subscribers to receive a real-time alert when the vehicle's alarm sounds.

AEG

POWERTOOLS

EXPERIENCE THE POWER



12V HAMMERDRILL/DRIVER
AEGBS12G2LI152C



14.4V HAMMERDRILL/DRIVER
AEGBSB14G2NCKIT1X

*** Compact and powerful
for all jobsite applications.
Batteries included.**

**Proudly distributed by L&G Tools.
For more info call 031 717 6800**

FORD SHELBY V8 FOR SHELBY GT350 MUSTANG

LEGEND IN THE MAKING

You are looking at the most power-dense, most powerful naturally aspirated road-going engine in Ford history. It's also the Blue Oval's highest-revving production V8 ever.

All to do with economy, of course.

Well, not *quite*. The word is efficiency.

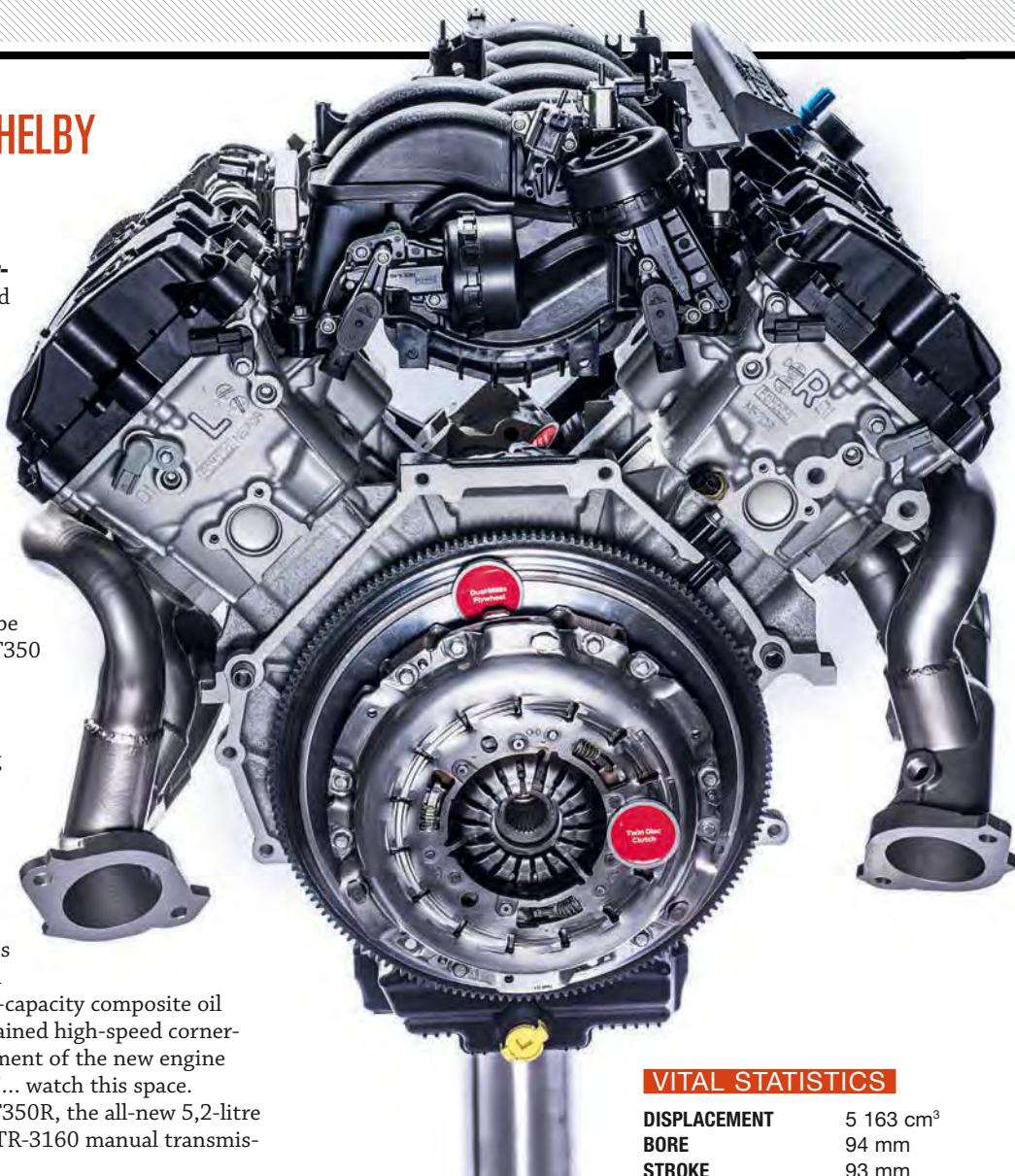
The new 5,2-litre flat-plane crankshaft V8 produces 392 kilowatts and 581 N.m. Specific output is over the magic 100 horsepower per litre of displacement, at 102 (76 kW) and it hits the red line at 8 250 r/min. It will be used in only two models, the Shelby GT350 Mustang and Shelby GT350R.

The objective of the Shelby GT350 programme was plain and simple: the most balanced, nimble and exhilarating production Mustang yet, according to Ford Performance chief engineer Jamal Hameedi.

The engine's unique new aluminium engine block features Ford's patented plasma transferred wire arc cylinder-liner technology. This process eliminates typical heavy iron cylinder liners with a deposition process. A lightweight, high-capacity composite oil pan contains baffling designed for sustained high-speed cornering and hard braking. Ford's announcement of the new engine makes liberal use of the the term "race"... watch this space.

In both Shelby GT350 and Shelby GT350R, the all-new 5,2-litre will be paired with a six-speed Tremec TR-3160 manual transmission as its only gearbox option.

Flat = fast. Traditional cross-plane crankshaft V8 engines attach the piston-carrying connecting rods to the crankshaft at 90-degree intervals, creating a "cross" of counterweights when viewed down the axis of the crankshaft. In the all-new 5,2-litre, the connecting rods attach to the flat-plane crankshaft at aligned 180-degree intervals – creating what looks like a flat line of counterweights when viewed down the axis of the crankshaft. The forged-steel flat-plane crankshaft is "gun drilled" to reduce total



VITAL STATISTICS

DISPLACEMENT	5 163 cm ³
BORE	94 mm
STROKE	93 mm
COMPRESSION RATIO	12,0:1

engine weight and to improve bay-to-bay cylinder breathing. Besides resulting in a crackling engine note not typical of a rumbling American V8, the flat-plane crankshaft helps improve cylinder exhaust-pulse separation by allowing a firing order that alternates ignition events between the V8's two cylinder banks. Better breathing equals more power potential.

AND, IN OTHER FORD NEWS...

Like it? Print it!

Ford has become the first car manufacturer to make 3D-printable files of its vehicles available at 3d.ford.com. Currently available models are the Focus ST and Fiesta ST; more are on the way. That's besides the existing library of more than 1 000 Ford images available to purchase and download. 3D fact: According to Juniper research, sales of desktop 3D printers will exceed 1 million units by 2018, from an estimated 44 000 sold annually in 2014.



Ford Fiesta

All-new F-150 Raptor





THE WORLD'S MOST EXPENSIVE CAR SHOW

THE ANNUAL CONCOURS D'ELEGANCE, HELD ON THE EIGHTEENTH FAIRWAY OF PEBBLE BEACH GOLF LINKS EVERY AUGUST FOR THE PAST 65 YEARS, GATHERS THE RAREST AND MOST BEAUTIFUL CARS FROM AROUND THE WORLD. THIS IS HOW THEY PULL IT OFF. BY ANDREW DEL-COLLE

THE EVENT

The Concours is on a Sunday and caps off Monterey Car Week, which consists of many geographically scattered functions – smaller shows, group drives, auctions, and races at Mazda Raceway Laguna Seca. Most cars arrive by Monday, and many participate in multiple events, requiring planning to keep Pebble's roads free.

SELECTIONS

As soon as one show is over, the selection committee begins fielding applications for the next year's Concours. Accepted applicants are notified in April and begin working with one of two key facilitators who co-ordinate national and international travel. It is the facilitators' job to make vehicle transportation as stress-free as possible for owners.

TRANSPORT

US entrants use trucking companies specialising in classic-car transport, private carriers, or single-car trailers. Some share trucks, and others will reserve an eighteen-wheeler just for their car. Overseas participants arriving by cargo boat or plane are first cleared by US Customs as duty-free with a limited visitation time, then put on a truck.

SHOW WEEK

During Car Week, US show vehicles are kept in their transporters at a designated location near the eighteenth fairway that can hold up to 200 trucks. International cars, which do not have to stay on trucks, are kept at a separate International Entrants Tent by the tee box. The tent can hold roughly sixty cars and is guarded at night by an armed sheriff.



ON INSURING RARE FERRARIS

"The fact that you can get six Ferrari 250 GTOs on a transporter logistically has nothing to do with the fact that nobody in their right mind is going to put six Ferrari 250 GTOs on a transporter and move it one inch. Nobody in the world would have that type of coverage."

– **Tim McGrane**
Executive director,
Blackhawk
Automotive
Museum, Concours
d'Elegance trans-
port co-ordinator

"We have one guy who has a GTO, and we've shipped it several times. He likes to book the car on the same flight he's flying on and never insures it. He says, why do I care if the plane goes down and I'm on it? That's an interesting way to look at it when you have a R500 million to R600 million car, right?"

– **Martin E Button**
President, Cosdel
International
Transportation,
which ships most
overseas entrants

PEBBLE BY THE NUMBERS



Most Concours Best of Show wins by a single carmaker: Bugatti.



Approximate number of Ferraris, a featured carmaker in 2015, expected this year.

200

Average number of cars shown on the fairway each year.



1 893

Number of truck drivers and staff fed at an annual BBQ hosted by a show regular.

Total years of Concours judging experience at last year's show.

ARE WE THERE YET?



13 681 km The longest distance a car was due to travel to the Concours this year. It's a 1949 Aston Martin prototype from Singapore.

41 Average number of cars per show from outside the US

Other countries 2015 entrants hail from: Japan, China, Australia, Argentina, throughout Europe.



THE OLDEST CAR AT THE 2015 CONCOURS D'ELEGANCE

1902 Panhard et Levassor
OWNER: Peter Mullin,
founder, Mullin
Automotive Museum

To even have a shot at winning the Concours d'Elegance, every car has to be able to drive down Pebble's eighteenth fairway and across the stage located in front of the clubhouse. Consider that a breeze for this pristine French-made 1902 Panhard. The front-engine, chain-driven car has a Daimler 2,3-litre four-cylinder paired to a three-speed transmission and can still hit its original top speed of 80 kilometres per hour. Contemporaries could manage only 25 to 30 kilometres per hour.



MOTO GUZZI V7 II RACER

CUSTOMISE YOUR OWN MODERN LEGEND

Back in its heyday during the seventies, Moto Guzzi's V7 Racer became the first mass-production bike in the world to exceed 200 km/h. Just as importantly, many Italian motorcycle aficionados consider it the most beautiful Moto Guzzi ever built.

Although paying homage to its venerable ancestor, the all-new retro-style Moto Guzzi V7 II Racer was built with modern riders in mind. Its frame now holds the classic 750 cm³ 90-degree V-twin engine 10 mm lower and rotates it 4 degrees forward. The result: apart from improving the bike's side view, it provides a lower centre of gravity, along with more legroom for taller riders. The completely new gearbox features six gears to help maximise riding comfort, thanks in part to the softer clutch that engages more easily and precisely. Plus, it comes with ABS and traction control.

Even better, the guys at Guzzi distributors The Cayenne Group have no intention of letting any two Moto Guzzi V7 II models leave their showroom floor looking alike. So, they've come up with a scheme that allows purchasers to customise bikes their own way. Craig Langton, sales director Moto Guzzi SA and co-owner of Cayenne, explains: "We've made various free options available. The list includes paint jobs, graphics, side panels, back and front mudguards, tank, exhaust and conversions to a café racer or scrambler. You can even have your own number on the traditional Moto Guzzi side plate."

To find out more, contact Cayenne on 011-244 1900 or visit www.cayenneworld.com
- SEAN WOODS

SPECIFICATIONS

ENGINE:	4-stroke V twin, OHV, 2 valves with light alloy pushrods and rockers
MAX POWER:	35 kW at 6 200 r/min
MAX TORQUE:	58 N.m at 5 000 r/min
FINAL DRIVE:	Shaft
WET WEIGHT:	189 kg
PRICE:	R139 900



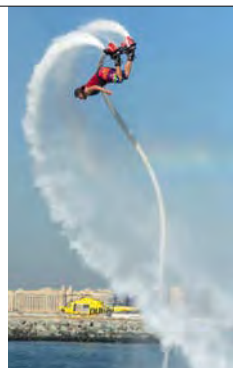
2015 ARCTIC CAT WILDCAT SPORT LIMITED EPS

Output: 45+ kW

With a modest 700-cubic-centimetre inline-twin riding behind the seats, the Wildcat isn't one of those rides you see on YouTube ripping wheelies across giant sand dunes. It's more like the Subaru BRZ of side-by-sides, a machine that prioritises balance over outright power. The Wildcat weighs only about 450 kilograms, and it has more than a 30 cm of suspension travel front and rear – which means it flits lithely across terrain that ought to make you feel like a carton of eggs that was dropped on the supermarket floor. The Arctic Cat should have no problem keeping up out on the trails, where its electric locking front differential gives you true four-wheel drive. And although the Wildcat is definitely biased towards fun, it retains some farm-duty pragmatism with a 50 mm receiver hitch and 680-kilogram towing capacity.



TIP:
This thing's so light that, if you're going to jump it, you might want to throw a couple of sandbags on the passenger-side floor to level your flight trajectory. Or find a suitably crazy friend to ride shotgun.



EXORBITANT PURCHASE OF THE MONTH

The Zapata Racing Flyboard repurposes the workings of a personal watercraft such as a Sea-Doo or a Jet Ski to create the wildest experience you can have on the water. By using its on-board jet pump to power water through a hose connected to a separate wakeboard-size platform, the Flyboard shoots highly pressurised water through two nozzles on the bottom of the board to fly as high as 10 metres or even dive below the surface. After about twenty ugly minutes falling into the drink, I was soaring above the water on my rocket boots. It's a singular feeling, hovering three metres above a lake while people on the beach frantically reach for their phones. The Flyboard ain't cheap, though: price in the US is about R120 000, plus the watercraft.

2015 BRP MAVERICK X DS TURBO

Output: 90 kW

TIP:
The Maverick comes with two keys: grey limits you to 75 km/h, and black unlocks all 130. If you let a friend drive, start off with the grey key.



Last spring I drove a 150-kilowatt custom buggy in the Mint 400 desert race and my co-driver derisively referred to the side-by-sides as golf carts. As in, "Downshift to third, we've gotta pass another golf cart." However, there weren't yet any BRP Maverick X ds Turbos out there. The Maverick is the first turbocharged utility terrain vehicle, or UTV, with an intercooled turbo adding 15 kilowatts to the standard 976-cubic-centimetre twin. With a Fox Racing suspension providing up to 400 mm of travel, it's actually kind of hard to jump the Maverick – the suspension just keeps drooping as the tyres stay on the ground, like trying to pull a stubborn cat off a sofa. It's also the coolest looking side-by-side out there: the twin silencers tuck up under the rear deck like a pair of jet turbines, and the frame, springs, and A-arms are nuclear green. The intercooler housing, just behind the seats, looks like a malicious extra-terrestrial's battle helmet.

2015 KAWASAKI JET SKI ULTRA 310 LX

Output: 231 kW

Kawasaki is the godfather of personal watercraft, to the point that people assume the words Jet Ski are generic. They're not. This is what a real Jet Ski looks like, a green glass fibre bullet powered by a supercharged 1,5-litre four-cylinder. With no transmission and no boost lag from the supercharged four, the 310 has the kind of throttle response normally reserved for, say, the Ferrari 458 Italia. That's not an exaggeration: an informal 50-to-80 acceleration test resulted in about 2 seconds, which is in the ballpark for a 458. The Ultra is also more than happy to chill. The stereo seems like a goofy feature, although cranking some Van Halen adds an element of fun to those no-wake zones. **PM**





Let's CHAT

The Internet of Things is coming to a home appliance near you soon. Anthony Doman finds out what it's like to communicate with his best buddy, the fridge

DO WE REALLY WANT SMART appliances able to share their innermost feelings? And just how safe are they in a world where cyber-crime lurks in every Wi-Fi hotspot?

Of course we're right to be concerned. Manufacturers of everything from cars to coffee makers are falling over themselves to embrace connectivity. In the quest for a competitive advantage, they've clearly realised, there are only so many ways you can reinvent the acts of washing, drying, vacuum cleaning and refrigerating. So they have had to move beyond efficiency and reliability to an area that's becoming more important in today's crowded lifestyles: convenience. And if that means being able to check what's in your fridge without opening the door – perhaps even at a distance, using a smartphone app – they're finding more and more ways to do just that.

At the forefront of these kinds of initiative are industry leaders such as LG Electronics, which hosted a South African media delegation at its South Korean headquarters to unpack some of the revolutionary, intriguing and sometimes just plain zany tech that we'll be exposed to soon. Load shedding permitting, of course.

LG's take on the Internet of Things is based on what it calls HomeChat. This service employs Natural Language Processing (NLP) and LINE, a popular mobile messenger app with more than 300 million users, to let homeowners communicate, control, monitor and share content with LG's latest smart appliances. How smart? Think camera-equipped refrigerator, for instance (not for selfies, but for monitoring the interior). Or a washing machine that allows users to start and download washing cycles remotely or a microwave oven that supports NFC and Wi-Fi for convenient control from any location.

HomeChat appliances feature a Quick



SMARTPHONE APP



LCD PANEL



CAMERA



Smart REFRIGERATOR

Using the industry's first built-in internal refrigerator camera positioned at the top of the main compartment, users can monitor what's inside their refrigerator on their smartphones or tablets. It's able to detect the opening and closing of the refrigerator and capture food items stored inside when last opened. Using HomeChat, users can immediately see exactly what they need to buy when they're at the grocery store or supermarket.

Smart Manager, using the built-in LCD panel or LG Smart Refrigerator smartphone app, also allows users to check the content of their refrigerator without opening the door.

A Freshness Tracker makes it possible to input a wide range of foods and beverages to keep track of expiry dates. Smart Manager can also recommend meal options based on the ingredients stored in the refrigerator, as well as daily and weekly meal plans based on the user's personal profile.

Button that enables fast and easy access to their most commonly used functions and give users the choice of three modes: Vacation, Away and Return-home. Besides convenience, there's also an element of fun, with a selection of more 40 unique LINE stickers to add an enjoyable, personal component to conversations. According to LG, "with an intuitive interface, HomeChat makes communicating with LG's smart refrigerator, washing machine or oven much like chatting with a close friend". Clearly friendships are not what they used to be...

"Today's intelligent home appliances offer a variety of useful functions but many consumers still find setting them up an extremely complicated process," says Seong-jin Jo, president and CEO of the LG Electronics Home Appliance and Air Solution Company. "Not only does LG HomeChat help simplify and enhance our products; it also delivers a unique user experience, adding even more value."

Smart BEDDING CLEANER

This cordless hygienic bedding cleaner is said to effectively reduce the number of dust mites and harmful allergens in beds and mattresses. With powerful suction and three distinct levels of cleaning plus the built-in UV sterilisation station, it ensures a more hygienic bed and the cleaner itself, reducing the chance of secondary contamination.



Our media contingent had the opportunity to pose questions to the company's vice president and head of home and appliance communications, Chang-Hee Han.

With the growth of the Internet of Things, what is LG's strategy when it comes to security? What if somebody hacks my fridge?

We are conducting a very in-depth study globally regarding security-related compliance issues. A security system is being created to prevent any kind of hacking from occurring; currently we are adopting a very strong firewall for our appliance server and implementing a security solution for our smart appliances. The idea is to work towards making sure that we leave no customer history on our smart products so that we have no customer data stored on the product. That entails building a very strong process and policies so that we keep up with the global compliance issues regarding customer data.

Could we see the HomeChat service come to countries with poor Internet infrastructure, such as South Africa and India?

Smart appliances, and HomeChat is included in that, are based on the Internet and connected environment. Currently the Internet technology and infrastructure are growing rapidly. What we expect is that in those regions where slower growth of the Internet is taking place, the pace will soon pick up and that will enable us to provide consumers with more smart features.

We are looking at the smart appliance in two perspectives:

- Connectivity;
- Sensors.

And when you look at the smart industry, there are three categories:

- Platform providers (Apple, Google);
- Companies that provide solutions and content;
- Companies with strength in devices, such as LG electronics.

And when it comes to sensors, these are applied to diverse smart appliances such as our robot cleaner, air conditioner and air purifiers. Sensors occupy a very important position in smart appliances.

Regarding weaker Internet infrastructure, what LG plans is to make the most of sensor technology so that the customer is enabled to have more convenience.

Would 3G be an option if there is no or inadequate fixed-line option?

Wi-Fi is better, but 3G and 4G are possible.

Turning to the subject of South Africa's energy problems, we are looking at rolling blackouts for the next few years. Your auto restart technology seems to be applied more to premium products. Will we see this technology applied to a wider range of products for South Africa?

Auto restart is available on almost every product; we can do it on everything except the twin tub.

You have quite a focus on robotic technologies on such things as vacuum cleaners. What kind of work are you doing to expand robotic technologies to your other appliances? And what are you doing with regard to battery life cycle costs, production and recycling?

LG is becoming a leading consumer electronics company providing convenience to consumers by being the first to release a full range of cordless vacuum cleaners to the world. Robotic consumer electronics will grow further.

Battery technology has a crucial role in that process. One of our sister companies, LG Chemical, produces batteries.

This company has great know-how and advanced technology in battery production. In fact it is one of the leading companies in the

world in the field of hybrid and electric cars and all of its technologies are going to be applied to our robotic technologies and cordless and other such appliances.

Although we plan to expand robotic technologies, currently we don't have a very detailed plan. We are willing to hear more from our customers about what they need.

For the near future what we are aiming to do is to add sensor technology and connectivity to our robot cleaners. In Korea, we recently launched a new feature for our robot cleaner: it also has a camera installed on the cleaner so that, from outside your home, you can use your smartphone to monitor what is happening in your home, as a security feature.

What are the considerations when you decide which appliances get to which market?

Our focus categories differ greatly depending on what region is under consideration. When you look at smartphones or TVs, they are a global product, which means that with a single model you can cover the whole market.

But when it comes to home appliances such as refrigerators, local standards all differ, user patterns differ and also there are very strong local players in the various markets. We strongly believe that we have to provide a customised service and product to each region so we tailor to the customer preference and user pattern of each country. And that is one of the principles of our product development.

Regarding the South African market, in washing machines, for example, we provide all three categories: the front loader, top loader and twin tub designs. For Southeast Asia, we focus on the top loader and in Europe we focus on the front loader. But at the same time, we have another global launch strategy, which is to make sure that our innovations can be expanded globally. So, for example, with our twin washing system launched at CES this year, our basic strategy is to expand this technology worldwide. **To sum up, there are two principles:**

- First to customise our product launch based on customer insight;
- Second to expand our innovative technologies globally.

To give you an example regarding air conditioners, we have some smart features and energy-saving technologies that are being applied globally, but at the same time there are technologies that are being applied locally. In South Africa, there are some areas with unstable power supply, so we have launched LVS technology, which stands for low voltage system, and AVS, which stands for all voltage stabiliser, so that our products and our customers that use our products are prepared for any kind of unstable environment. Also, electricity supply is a very big issue globally, so we are emphasising innovative technology and that is why we are focusing on the inverter technology for the South African market. We have dedicated teams that go out to each market so that they have an in-depth idea of the customer in that particular market and the environment to ensure that each product is tailored to that environment.

As an example of regional preference, Korean people want bigger-capacity washing machines – up to 19 or 20 kilograms capacity. But South Africans prefer less capacity, perhaps 7 to 8 kilograms. Another example is air conditioners.

In Mozambique, they have a big mosquito problem, so the designs we sell there have a feature that minimises problems with mosquitoes. In South Africa, the vacuum cleaner market is small because many people don't clean their homes themselves, unlike in Korea where the vacuum cleaner market is huge and there are products such as the cordless and robotic design.

Smart WASHING MACHINE

With HomeChat, consumers can remotely control and monitor their LG smart washing machine from outside the home. By texting *start washing cycle* when they head for home, LG's smart washing machine will ensure that the laundry is completed by the time they get home. And by texting *what are you doing?* users can receive real-time updates on the washer's progress. Wash cycle updates can be downloaded via a Wi-Fi connection using the built-in touch screen.



Smart LIGHTWEIGHT OVEN

Select *Return-home* using HomeChat and this smart oven will ask, *what dish would you like to make today?* and open the Recipe Search window. When ready to cook, the oven will set the temperature and cooking time. Smartphone recipe alerts can be pushed to users.



PM



Eddie van Halen with his famously customised guitar, Frankenstrat, at his workshop in Los Angeles.



EDDIE VAN HALLEN

IS A GOD

He's also an inventor and patent holder who has spent the better part of 35 years in his workshop, deconstructing and rebuilding guitars and amps, searching for his signature sound. Insight from a rock legend and insatiable tinkerer.

By Eddie van Halen

Photographs by Nigel Parry

I'VE ALWAYS BEEN A TINKERER.

It comes from my dad. Growing up, we lived in a house in Pasadena that had no driveway. You used an alley that ran through the middle of the block, behind all the houses, to get to your backyard or the garage. Well, the neighbour behind us had a U-Haul trailer up on car jacks and loaded with cinder block. One night my dad came home from a gig at three in the morning. He had a little heat going, he'd had a few drinks, so he says, "This thing is blocking me from getting in again." So he got out of the car and tried to move it. As soon as he lifted the trailer, the jack fell over, and it chopped his finger off.

This was a problem. Besides the obvious reasons, he played clarinet and saxophone. On a sax, you don't need to seal the hole with your finger. A valve closes over it. But with a clarinet, you have to seal the hole, so he took a saxophone valve cover and adapted it to work on his clarinet.

Another funny thing was later in his life, when he started losing his teeth. You need your bottom teeth to play a reed instrument. Instead of going to the dentist, he made himself a perfectly shaped prosthesis out of white Teflon that filled the gap where his teeth were missing. He slipped that in when he had to play. Watching him do that kind of stuff instilled a curiosity in me. If something doesn't do what you want it to, there's always a way to fix it.

STOCK GUITARS

My playing style really grew from the fact that I couldn't afford a distortion pedal. I had to try to squeeze those sounds out of my guitar.

The first real work I did was in my bedroom. I added pickups, because I didn't like the sound of the originals. I couldn't afford a router – I didn't even know what a router was – so I started hammering away with a screwdriver. That didn't work at all. Chunks of wood flew off and there was sawdust flying all over the place. But I was on a mission. I knew what I wanted and I just kept at it until I finally got there.

Most guitar necks are too round on the back, so I took sandpaper and reshaped the neck to be very flat. I actually refretted a few guitars early on because I wanted to shave the fingerboard down and make the neck even flatter. The flatter it was, the farther I could bend a string without fretting out, or choking the sound when the string hits a fret higher on the neck. The other issue, with Fenders, at least, was the clear lacquer they'd put on the neck. When you sweat, your fingers either slide all over the place or get sticky.

PLAY LIKE EDDIE

Or at least look a little more like him when you do play. Eddie started manufacturing his own equipment in 2007 under the brand EVH Gear. His newest offering, the Wolfgang WG Standard (far right), launched in the spring. Named for Van Halen's son, the entry-level guitar is made from extremely lightweight and porous basswood, providing the perfect resonance for musicians who are heavy on the treble and fade. The neck is maple, with a deliberately minimal satin finish. "The more porous the wood, the more tone you're going to get," Van Halen says. "My guitars aren't sealed, so they breathe. The sap can escape, allowing the wood to age." If you get good enough to really wail, the specialty Floyd Rose bridge locks the strings to the body in two places instead of just one, so the guitar stays in tune, even when you hit a dive bomb – the high-pitched whine at the end of the song that you know you're going to try.

From left: Wolfgang Special, Stripe Series Black and White Stripes and Wolfgang WG Standard, the cheapest of the group and at around R9 000 about half the price of the 5150III, the 5150III Combo amp.



I couldn't stand that, so when I built my first guitar, I used natural wood. My own sweat and oil would soak in to make it smooth. It took a lot of playing to get it that way but, eventually, it just felt so much better than any synthetic product you could put on there.

THE WHAMMY BAR

Vibrato bars (also called whammy bars or tremolos) just didn't stay in tune. The problem was the nut – the string guides at the end of the guitar neck. On the first album I used a standard, non-locking Fender tremolo. The string is angled down from the nut to the tuning pegs, creating tension that, after the string slides back and forth when you use the whammy bar, keeps the string from returning to its original slot. I made my own nut with really smooth indentations – big and round like the bottom of a boat. I put a drop of 3-In-One oil in there, too, so the string would be extra slippery. On top of that, instead of winding the string down on the tuning peg, creating an angle and causing that tension, I would wind it up so that, from the nut all the way back to the bridge, the string was level. Otherwise there could be hangups in the nut that would make the guitar go out of tune when you went crazy on the whammy bar. The only problem this caused was when you hit an open string, where your fingers aren't holding it down. Without that tension, the string would pop out of the nut slot, so I'd have to remember to put my finger on the far side of the nut to hold things together.

AMPS

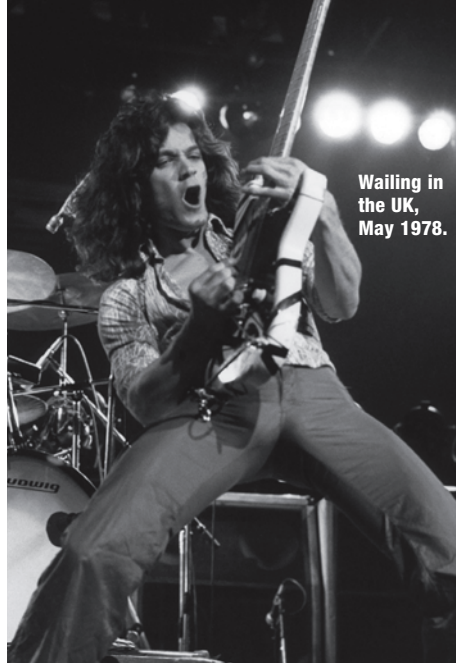
If it was movable, or turnable, or anything that resembled something that could go up or down, I would mess with it to make the amp run hotter. I opened the amp up and saw this thing. I found out later it was a bias control, which controls the power to the output tubes. I'm poking around, and all of a sudden I touch this huge blue thing and my God, it was like being punched in the chest by Mike Tyson. My whole body flexed stiff, and it must have thrown me a couple of metres. I'd touched a capacitor. I didn't know they held voltage.

The Marshall amp I brought home from the store where I worked was only good if you turned it all the way up. Any lower and you'd lose the distortion. I needed that, but it was impossible to play anywhere with the volume that loud, so I tried everything, from leaving the thick plastic cover on it to facing it backwards to putting it face down. I'd blow a fuse twice an hour.

Luckily, I stumbled onto the Variac transformer soon after. I'd bought another Marshall amp, and I had no idea that it was actually a European model. I plugged it in, and I'm waiting for it to warm up and thinking, I got ripped off here, there's no sound coming out! Pissed off, I came back an hour later to give it another shot. I'd left the amp on the whole time. I didn't know it was set on 220, so when I turn my guitar on it sounds like a full-blown Marshall, all the way up, except really, really quiet. That was when I realised there was something going on with the voltage. There were these cheesy light dimmers in the house and I hooked it up to one of those. Of course, I wired it backwards and shorted out the whole house, so I went down to a place in Pasadena and asked if there was some kind of industrial-size variable transformer that would let me adjust voltage and they introduced me to the Variac. It's just a huge light dimmer. I plugged it into the amp and controlled the voltage from that. That became my volume knob. I would set the voltage depending on the size of the room we were playing, getting all that feedback at any volume.

PICKUPS

My first real guitar was a Les Paul Goldtop. I was a total Eric Clapton freak and I saw old pictures of him playing a Les Paul. Except his had humbucking pickups, and mine had the soapbar, P-90 single coils. The first thing I did with that guitar was chisel it out in the back and put a humbucker in. When we were playing gigs, people kept saying, "How is he getting that sound out of single-coil soapbar pickups?" Since my hand was covering the humbucker, they never realised that I'd put it in.



Wailing in the UK, May 1978.

THE PATENTS OF EDDIE VAN HALEN

He had three. One expired earlier this year. Two remain.

US PATENT

#388117

Guitar peghead:

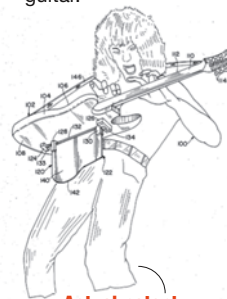
Placing the tuning pegs on the opposite sides of the headstocks helps the strings hold tension. It also obviates the need for string trees, guides that clamp down on your strings and hinder string replacement.

US PATENT

#4656917

Musical instrument support:

A bracket that swings down from the back of the guitar, supporting it at a 90-degree angle from your body and letting you play the instrument like a lap guitar.



Actual patent illustration!

When my guitar was black and white, I cut out my own pickguard so it would cover the holes from the pickup I'd removed. But when I painted red on top of the black and white, which is how it is now, it didn't look cool with that black pickguard. It covered most of the paint job. I decided just to take the switch and cram it in the middle and put a non-working pickup in the front because I didn't use it. I wasn't trying to trick anyone. Bottom line is, I didn't know how to hook it back up.

The last real step for me was adding paraffin wax to my pickup. Pickups can have this really high-end squeal, like the annoying screech of feedback you sometimes hear when someone speaks into a microphone. I thought maybe what was causing that with a guitar was the coil windings vibrating. So what I did – and I have no idea where this idea came from – was buy a hot plate and bricks of paraffin, and borrow a Yuban coffee can from my mom to put the wax in. Of course I ruined a lot of pickups, because the plastic frames would melt before I had a chance to yank the pickup out. But finally, when I had a chance to really keep an eye on it, as soon as I saw the pickup start to heat up and shrivel a little bit I'd yank it out. Man, the first time I put that in – between the Variac, the beast that Marshall was and now the pickup not having unwanted feedback – the combination was just ideal. That was heaven to me. When all those things came together, it was like, okay, I'm going crazy with the whammy bar, I got my Marshall with the Variac, there's no stopping me.

PM

SWEAT ETHIC

Compiled by
LINDSEY SCHUTTERS
ANTHONY DOMAN

Two-wheel commitment

A comprehensive guide to cycling from a non-cyclist

South Africa, according to bicycle shop owners, is race country, so the local bike shops (LBS) carry only bikes and components to support the Lycra-clad crowd. The problem is that performance-focused components seldom manage to cater adequately to the needs of the growing number of commuters who just want to get to work and save the Strava-ing for the weekend. The choice is then to risk your purpose-built expensive carbon speedster on the mean streets, or invest in two inferior bikes. But we like tinkering here at Pop Mech, so we found another angle of attack.

THE RETRO ALTERNATIVE

A modest 10,5 kilometres

from door to door, my commute for the past 20 years follows a line running roughly north-south. En route, hazards for the bicyclist include motorised rat-runners, the southeaster in summer, the northwester and rain in winter, a mean dog (now thankfully grown too old to chase much) and two traffic light intersections that require cojones of reinforced chrome-molybdenum steel – like the stuff used to make the frame of my pack mule. My choice of steed for the hurly burly of the Cape Town commute is a classic lightweight Eddy Merckx Corsa Extra, in the mid-90s colours of team GAN, colours once campaigned in the Tour de France by Greg Lemond. It's outfitted for unsupported long-distance events (*audaxsa.co.za*), so works well for commuting: dynamo hub, LED headlight with road-specific optics, capacious saddle bag, wide-range gearing, comfortable accommodation and protection from the elements (you *do* know that you get wet from the road, not from the sky?). Although the reliable modern drivetrain isn't period-correct, the hand-sewn English cotton duck saddle bag and venerable Rolls saddles add a suitably Fredly vibe along with the Merckx's lugged steel.

In the bag: Hi-viz vest, two spare tubes, patch kit, Leatherman Juice, Topeak multitool, Indola waterproof jacket, Petzl E-lite, two tyre levers. Oh, plus cable ties and ziplock bags. – AD

STEADY EDDIE: IN DETAIL

FRAME	Columbus SLX chromoly steel
SADDLE	Selle San Marco Rolls
DRIVETRAIN	Campagnolo Mirage 9-speed triple
CHAINWHEEL	52/42/36
GEAR RANGE	13-26
PEDALS	Shimano PDA520
TYRES	Continental Gatorskin 700 x 25
STORAGE	Carradice Barley on Bagman QR Sport rack
FENDERS	SKS Raceblade XL
COCKPIT	Ritchey aluminium stem, seatpost and bars
LIGHTING	SON 28 hub dynamo driving B & M Cyo IQ Sport front, B&M Seculite rear
WHEELS	32-spoke, built by Johan Bornman
PUMP	Topeak Road Morph
WEIGHT	12 kg



THE ONLY



Tyres: Tubeless is the future, but still expensive. A tube with some slime and a tyre with some armour like Schwalbe's supposedly puncture-proof Marathons will do you fine. that said, beware of pinch flats on your tubes if you're running skinny tyres (<40c) off road. The bike owner, CAR Editor Steve Smith, loves mountains and went tubeless for that exact reason.

Wheels: Commuter bicycles are supposed to be universal so that you can walk into any bike shop and be able to get spares. The dominant wheel size at the moment is 29-inch; you'll want to spec your steed with **29er rims** and benefit from endless tyre options. Cotic's Escapade has room for the monstrous size and clearance for up to 40c thick tyres for a nice fat ride.

Backpack: Thule Pack 'n' Pedal Commuter
Reflective bits, mounting points for lights, protected laptop compartment and a place to store your helmet make for a near-perfect commuter bag. Go for the Commuter Pannier version if you're equipping your bike with racks (it also doubles as a sling bag for that bike messenger look).



BIKE YOU'LL EVER NEED

Clothing: Merino wool

A merino base layer will keep you warmer in the winter, cooler in the summer and draw sweat away from your skin better than any other fibre. Plus, you get odour resistance that could see you through about a week of daily wear between washes. Choose a Goretex top layer for max breathability, wind and water resistance.

Handlebars:

While the mountain bike's wide, flat bar creates the great upright riding position, the flexibility of multiple hand positions offered by **drop bars** makes for a much better ride if you're doing longer distances. Go full cyclo-cross and opt for drops; you can also ride with a "hipster grip" to stay upright.

Lights: Knog Blinder

They're not the absolute brightest, but the **Blinder 4** series of front and rear lights (with 4 LEDs) come in great designs and have practical flashing profiles and built-in USB charging, which eliminates the extra charging cable that you'd invariably lose.

Fork: If you're bombing down cliff faces and granite stairways on the regular, sure thing, go full sus. But for gravel travel and a bit of jeep track on the weekends and commuting to work in the week, save some cash and go rigid. Yes, suspension makes difficult trails more accessible to regular folk, but the trade-off is introducing another potential point of failure, more weight in your set-up and more money out your pocket. Steel forks offer mounting options and surprisingly good damping.

Brakes: Contrary to popular belief, V-brakes are very effective at stopping a bicycle. Discs are better in the wet, though. Go for mechanical discs because they're easier to service than hydraulics – and brake cables are easier to replace than hydraulic lines.

Gears: This is a decision best made after an analysis of the hills on your regular commute.

We prefer the sealed-up nature of internal hub gears because you can then actually take your bike to play in the mud without worrying about doing damage to your drivetrain. We like **Shimano's Nexus 8** eight-speed, but you could opt for a newer Alfine hub for smoother shifts and more gears on the 11-speed model. A single chainring rules out extra complications and allows for larger and more effective chain guards.

Frame: Choose steel because it's strong, relatively cheap and, if not equipped with various mounting points for things like fenders and racks, will at least be tough enough to be able to mount adaptors like p-clips. We like the **Cotic Escapade** (R6 300 for frame and fork, cotic.co.za) because it blends touring elements with some cyclocross geometry for rugged reliability, agility and all-road ability. Modern steel frames are also a lot more advanced than the ones you remember: this butted chromoly unit rivals aluminium for weight at 10,7 kg with wheels on. If you want something made closer to home you'd be well served to give David Mercer a call, but the waiting list stretches well into 2016 for a custom-fitted rig.



Or wait for this...

Cannondale is launching an all-road bike called the Slate later this year. They say it's based on the Synapse, but with disc brakes and a Lefty fork with 30 mm suspension.

SWEAT ETHIC

Power rating 500 W → **Top Speed** 30 km/h using motor power only → **Range** 25 – 50 km depending on rider weight, terrain
Measurements Frame size 51 cm, Axle to Axle 117 cm, Handlebars 23,5 cm → **Warranty** Bicycle 1 year, battery 3 years limited
Weight Bicycle 23 kg; battery pack 3,2 kg
Price: R35 650

Battery pack

48 V 10 Ah li-ion
(smart charger
included)

Motor

Brushless geared
hub motor on rear
wheel

Brakes

Avid BB-7 Disc

Handlebars

City Style with
single lever
multi-adjustable
stem

Frame Type

6061 aluminium

Pedal Assist

5 Levels (throttle
only is at Zero
Level)

Gears

Shimano,
7-spd

Tyres

Schwalbe Fat
Frank 28 x
2.00

NOW WE'RE CRANKIN'

There are nine million bicycles in Beijing. That's a fact. At least, according to Katie Melua.

But while the songbird was linking undying love to the two-wheeled life-style, did she notice how many of those bikes were actually being pedalled? Because China, prompted by government support, is where the E-bike boom began in the 1990s.

It's still the world's biggest market for this mode of transport, with 85 per cent of global sales, according to a report by the International Lead and Zinc Study Group. Projecting on that report's estimates, by now well over 200 million E-bikes should be running around there. (Why the study group is interested in E-bikes: the Chinese versions largely use lead-acid batteries.)

Because E-bikes in China tend to use lead-acid battery technology, they are cheap at an average of R2 000. In more developed regions, more efficient lithium-ion battery tech boosts prices significantly: North American bikes average R10 000 and those in Western Europe R18 000.

The Pedego City Commuter on test here, one of a nine-model range, uses a lighter, more efficient – and hence more expensive – lithium-ion energy pack. There are two variants of City Commuter: Classic, with a frame like a compact road bike's with sloping top tube, and Step-Through. They cost the same, the Classic possibly being more rigid and the advantage of the Step-Through being easier mounting and dismounting.

The City Commuter's imposing bulk can feel a little intimidating at first. That impression gains traction when you start to attempt to manoeuvre it. It's heavy.

With your left hand twirling the Shimano 7-speed twist-grip shifter, it's possible to pedal it with moderate effort – on the flats, at least. But that's not nearly as much fun as twisting the shifter on the *right* handlebar to go zooming up to the Pedego's unpedalled top speed of 30 km/h.

Five grades of pedal assist (plus 0 for pedal-free riding) provide enough range for most levels of fitness and ability. For somebody like me who works out at moderate intensity

three to four times a week, less assist is fine. Level 3 seemed to hit the sweet spot, allowing me to bomb along at between 25 and 30 km/h on the flat, or climb hills almost effortlessly at speeds normal riders can only dream of. The pedal assist also provides a quick, welcome boost up to cruising speed from pull-away or exiting slow corners. Range? Using Level 3 and pedalling steadily, after three trips of about 10 km each, two of them with lights on, the display showed about three-quarters charge remaining.

The handlebar-mounted control unit has four buttons for power/lights, assist mode (+ and -) and one to cycle through the LCD readout, which displays speed, distance, charge state and pedal assist mode. On the battery itself, a row of LEDs also indicates charge state. Our City Commuter's battery slides out for charging convenience, though it can be locked in position for security.

Downsides: The bulk and weight were a distinct liability when I noticed, too late, the diesel spill across the white-painted STOP on the roadway. Now, I can add a bruised shoulder to my tennis elbow. Trying to refit the chain afterwards was a real pain, too: the lugs that hold it in place make it much harder to get it back on the chainwheel.

Oh, and the big seat, with suspension seatpost, is fine for gentle pedalling, but chafes the inner thighs for those who like to turn the cranks with a high cadence. In fairness, though, it isn't aimed at racer dudes. The beauty of the E-bike: adapting to a more leisurely pedalling style doesn't have to mean a slower speed.

The Verdict

The E-bike has the speed, range and equipment to make it a viable commuter for softie cyclists or hardened traffic jammers alike. It could do with a more robust pannier or rack, though. It's not cheap, but it has scooter-like performance without needing either a driver's or vehicle licence. And of course, there's that priceless benefit: it's a bike. If the battery dies, or the mood takes you, just pedal. – AD

On test: Pedego City Commuter E-bike

WHAT'S AN E-BIKE?

- Bicycle with auxiliary electric motor to boost pedalling power, usually limited to 0,25 kW
- Must retain the ability to be pedalled
- Top speed (unpedalled) usually restricted to 25 km/h
- For licensing and law enforcement purposes, regarded as a bicycle (although New York in the US deems them motor vehicles)

THE ULTIMATE BIKE VALET

You know when you get your bike back from the workshop, brightwork glinting like new, frame tubing buffed to a lustre deep enough to dive into, and hovering over it all a heady perfume of polish mingled with chain lube – plus a mysterious sweet scent you could swear is lip gloss? Liqui Moly's new range of DIY bike products aims to give you a pro-style finish with the minimum of hassle. In a one-litre bottle, the Bike Cleaner is a simple spray on/leave for two to three minutes/ rinse off operation. There's also a chain cleaner aerosol spray that cuts the crud alarmingly effectively, which explains the prominent warning signs. Lubricants in the range include a universal aerosol chain spray, two specialist chain oils (one for dry, dusty conditions and the other, biodegradable, for the wet) and a penetrating water- and rust-displacing multifunction component spray. Rounding out the range is an emergency tyre-fix sealant formulation.



THE SCIENCE OF STAYING UPRIGHT

More of us than ever are participating in organised sport – and as a result it's a common sight to see people hobbling about. Here's how to stay healthy.

We put our bodies on the line for some pretty arbitrary achievements. But staying fit and healthy while participating in an activity is not entirely your responsibility, though. Preventing injury depends on your actions and preparation, the quality of your equipment and facilities, and how well the organisers have done their job. The rest is a complicated matrix of techniques and strategies to maximise the positive effects of your training and staying competitive, but within yourself or the boundaries of your training. If that's a confusing, don't fret. Science has the answer.

What's the safest exercise to do?

Sports Science guru Dr Ross Tucker says it's complicated.

"Nobody has studied injury risk (among commercial training programmes) in a systematic way. It's not like for soccer, rugby or running where scientists have very detailed databases of how many people are doing the activity and how many injuries are happening. You need three things to know risk: 1) How many people participate, and how often; 2) how many injuries happen over a given time period, and 3) what injury is happening. All three require a very rigorous approach," he says.

"I'd rank, in order from least to greatest risk, as pilates, yoga/aerobics and cross training. Running has a high risk of injury. Cycling's risk of injury is low for in the gym, higher and more serious on the road. These are not the same kinds of injuries as someone gets when they have a tendon strain, though."

Dr Tucker has warnings for your corporate league too. "Any contact sport has high injury risk. Any activity that involves repeated impacts has a higher injury risk. That's why running's risk is higher than cycling, for example."

"And finally, improper technique enormously increases the risk of injury. If the person is doing yoga stretches improperly, or excessively, there's risk. Same for any weight lifting. If you do it properly, you cut the risk big time, but the problem in class settings is that there's potential for 'neglect'. People have to take responsibility for their own health and make very sure they are using correct technique."

VERDICT: Cut down injury risk by limiting the rate of increase in volume (slower is better), the intensity (lower is safer).

Fight injury with your stomach

According to research published in the *Journal of Sports Science*, nitric oxide may improve circulation to the working muscle and improve anaerobic recovery. The, ahem, takeaway? Beetroot juice. Apparently the maker of pink wee carries high levels of nitrates, which relax blood vessels to increase blood flow.

Beta-alanine, the amino acid, found in poultry, pork, beef and fish, is another nitric oxide merchant. It can be taken in powder or pill form and produces only about one-eighth the nitric oxide yielded by nitrates. But it also slows down production of lactic acid in muscles during exercise, and that can help prevent the sensation of fatigue.

With regard to recovery nutrition (post workout), research published in the *Journal of the American Dietician Association* recommends that, if an athlete has less than 24 hours to recover, glycogen levels in the muscle must be restored and an anabolic environment created to slow muscle breakdown. Carbohydrate ingestion of 1 to 1,5 g/kg combined with 15 to 20 or 30 g protein is the current recovery suggestion within 30 minutes of exercise.

Dealing with muscle pain

"Rest is the only thing," says Dr Tucker. "The pain is a symptom of the body trying to repair microscopic muscle damage. A hard bout of exercise damages the muscle in the same way that an earthquake damages the buildings of a city. The body corrects that by sends in the biological equivalent of dump trucks and wrecking balls to first clear out the debris, and then it rebuilds the muscle, stronger than before. That's why, once you have had DOMS (delayed-onset muscle soreness), you tend to avoid it in the future."

The downside is that, for 24 to 72 hours, depending on the severity, your muscles are swollen and sensitive. If you take anti-inflammatories to minimise or reduce the pain you are getting in the way of an important biological process.

A study published in the *British Journal of Sports Medicine* found that although massage soon after exercise didn't improve hamstring function, it did reduce soreness 48 hours after.

For back pain a double-blind, placebo controlled trial at Canada's Rothbart Pain



Management Clinic found infrared therapy halved chronic lower back pain over six weeks. As for pain medications a comparison in the *Clinical Journal of Sports Medicine* found ibuprofen and bromelain to have no effect on relieving DOMS.

VERDICT: Rest, massage and infrared offer the best relief. If you're feeling brave, dry needling (acupuncture) has proven effective for alleviating muscle pain, but more studies are being done to refine trigger points. – LS

THE GOLDEN RULES OF INJURY PREVENTION

These guidelines have been standardised by the American Academy of Paediatrics, but apply to us bigger children, too.

Take time off. Plan to have at least one day off to allow the body to recover.

Wear the right gear. Players or participants should wear appropriate and properly fitting protective equipment.

Strengthen muscles. Conditioning exercises during practice will strengthen muscles and connective tissue used in play.

Increase flexibility. Stretching exercises before and after activity increase flexibility and stretching should also be included into a daily fitness plan.

Use proper technique.

Take breaks.

Stop the activity if there is pain.

CROUCH... BIND... SET!

When the 8th Rugby World Cup kicks off in England on 18 September, one of the biggest contests won't be played out between 30 burly dudes on the grass – but by fabric scientists in the lab

Nine fiercely competitive teams are squaring up in the 2015 Rugby World Cup. No, we're not talking about the teams of internationals battling it out for the Webb Ellis Cup, of which there are 20.

The nine we're referring to are the official apparel suppliers. The bulk of the World Cup teams – albeit not the favourites – are being supplied by Australian company BLK ("Beyond Limits Known"). BLK's roster of six includes the USA, Fiji, Tonga, Georgia, Samoa, and Romania.

The reigning apparel champion, though, is adidas – by virtue of its 16-year link-up with New Zealand's All Blacks. The company also sponsors France and Italy.

Also sponsoring three is Canterbury, signed up to England, Japan and Ireland.

A recent entrant clearly hoping to make the leap from the more familiar territory of footwear to rugby, ASICS has signed on as official technical kit sponsor to both South Africa and Australia. The remainder are made up of Under Armour (Wales and Canada), Gilbert (Uruguay), Nike (Argentina), Macron (Scotland) and Brutal (Namibia).

What's becoming increasingly evident is that cutting-edge tech is engineered into the clothing to ensure that it performs at the highest level. Scientists at the ASICS Institute of Sport Science in Japan, for instance, are said to have refined the SA and Australian outfits using three-dimensional body maps as well as input from players. Rival BLK says each player's jersey has been specifically cut and tailored to the individual's body, featuring a combination of three fabrics strategically engineered to combine comfort and mobility.

Right, Springbok prop Tendai Mtawarira tries on the new RWC 2015 kit for us.

Reinforced seams.
Avoids tearing.



Bonded GPS pocket with stretchy neoprene.

Limits skin irritation, fits GPS units of various sizes and limits irritation.

Silicone grip technology.

Graduated gripping areas, optimally shaped, from the ribcage downwards help ensure a better grip of the ball while maximising fabric breathability.



Motiondry technology. This quick drying, breathable material ensures that the jersey stays lightweight during play.

Weight-saving. The shirt is 70 grams lighter than anything that's gone before.

Horizontal stretch. Snug fit without feeling clingwrapped.

Blocked vertical stretch. Stops opponents getting a good grip.

SOCKS

Graduated compression fabric. Helps biokinetics and blood flow.

Moisture-wicking yarn.

Cotton footbed. Better grip in the boot.

Nano-glide technology. In the heel and toe, to stop blisters.

SHORTS

Woven fabric. Hard-to-grip design.

Towelling patch. Dry hands help with ball control.

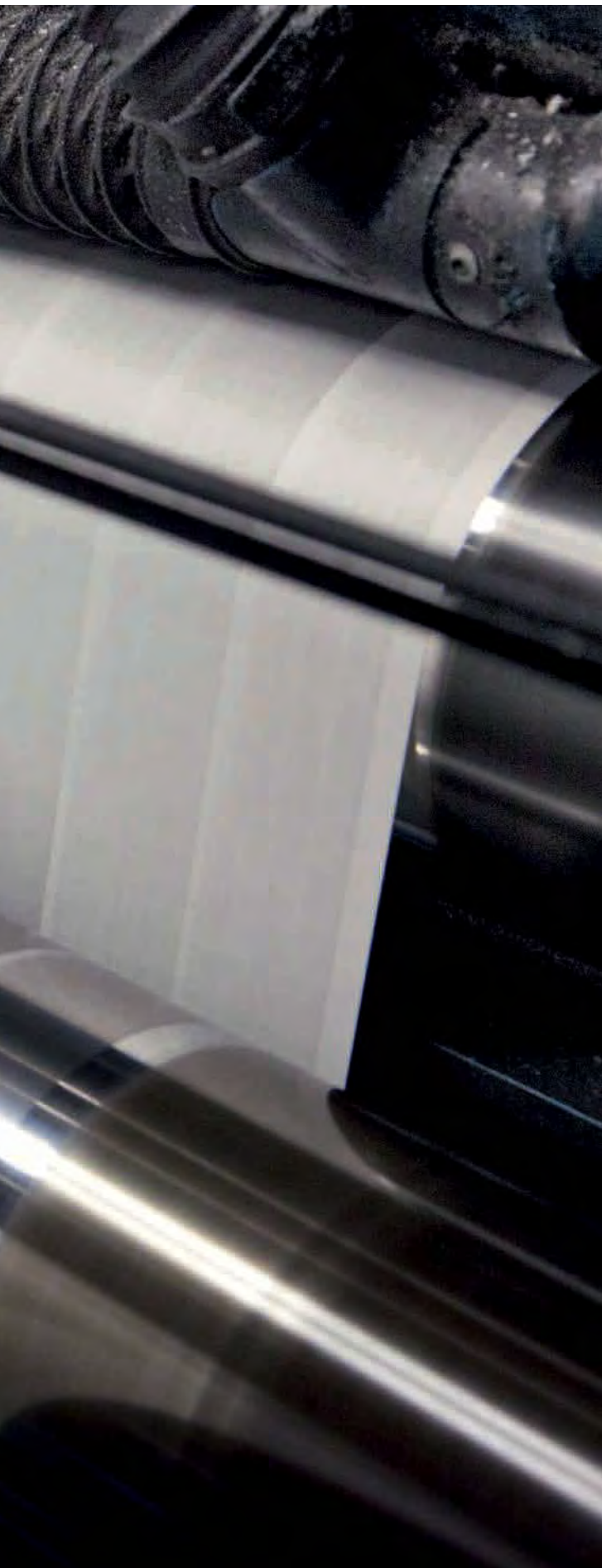
Snappy weave. Grabbable when necessary for scrum binding, but quick to snap back, minimising gripping in the tackle.

3D badging using hot melt technology. Saves weight; more importantly, improves visibility on TV.





At the main printing plant in Queens, seven presses run between six and eleven hours a night to print 300 000 copies.



THE DAILY MIRACLE

How *The New York Times* works.

By REEVES WIEDEMAN
Photographs by WILL STEACY



**1:35 A.M.
A TUESDAY** ERNIE BOOTH, THE OPERATIONS MANAGER OF THE MAIN printing plant of *The New York Times*, is walking the floor. The plant is a 48 000-square-metre building in Queens, on the Van Wyck Expressway, a kilometre from LaGuardia Airport. Booth is a big man with enthusiasm to match his heft, and tonight he's wearing a collared shirt, sweater and chinos in various shades of beige. He glides through the place like a small-town mayor, jabbing the noisy air with quick chin nods, offering ritual greetings to some of the 350 employees who work here each night.

"What's happening, Tom?"

"Hey, Andy."

"All quiet, Dennis?"

Dennis Díaz, a co-ordinator in the control room, responds that one section of the plant's 23 kilometres of conveyor belts is not working.

Booth draws a breath and scans the control room, a glass-walled office he compares to an indoor air traffic control tower, overlooking the floor. "You see all these flashing things?" he says, pointing to one of several screens displaying different parts of the plant.

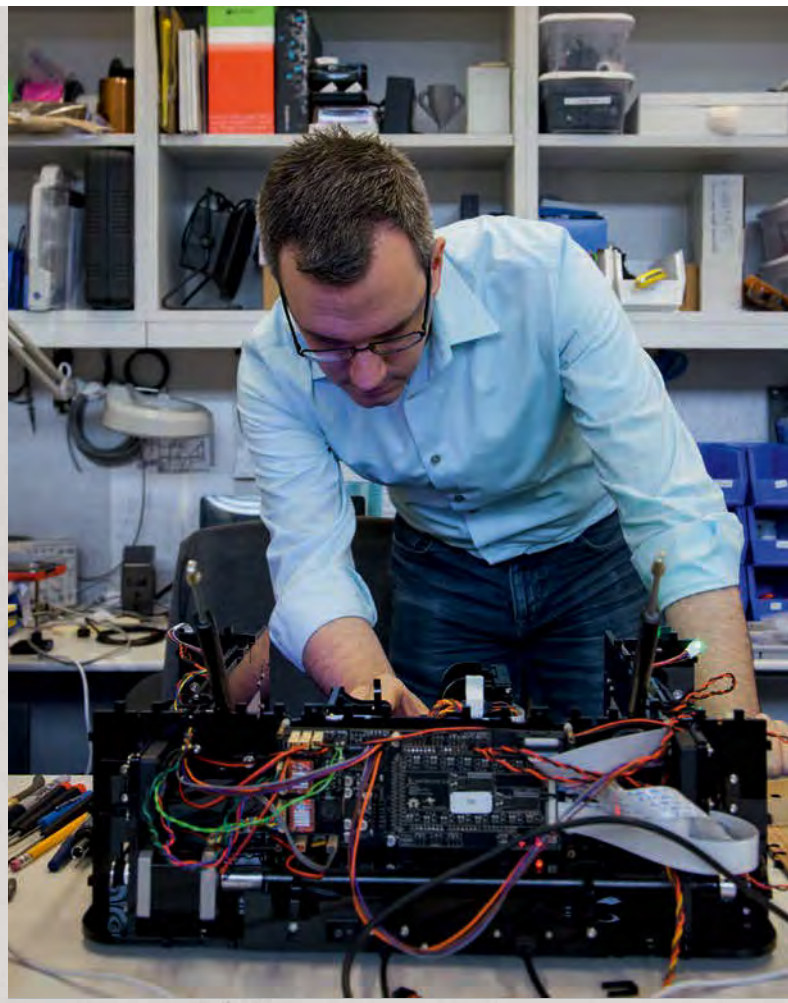
"Flashing things are bad. Flashing things mean we have a problem." He appears to have a lot of problems at the moment. But this night is not much different from

most and Booth's only real complaint as he circulates the floor is that he'd rather be on his wheels: the plant is so large that many employees travel from one area to another on adult-sized tricycles. (Booth has a trike and a golf cart.) During daylight hours, when the plant isn't in use, the *Times* sometimes rents it out – in the most recent Jason Bourne movie, it stood in as a crowded factory in the Philippines.

Tonight, like every weeknight, the plant will print more than 300 000 copies – double that on the weekend – which by 3:25 am. have to be loaded on to dozens of trucks. The straight trucks, which are already at the loading docks, can fit eight pallets each, holding a total of 14 000 individual copies. The trailer trucks carry twenty-four pallets, a load of 50 000 copies. The trucks will make about eighty departures from the plant by tomorrow morning, fanning out to other distribution points, from which the copies will be delivered to grocery stores, markets, office buildings and newsstands from New Haven to Albany to Trenton. Booth used to spend his nights waiting for the trucks to arrive – he had a *Times* paper route in the Riverdale section of the Bronx starting in 1986, when his daughter was born and he needed extra income.

Booth got here at 4 pm and will work until the last truck leaves. "Sometimes we'll get out at 3, sometimes we'll get out at 7," he says. "You're dealing with night people – we're vampires here." Tomorrow morning, most readers will think nothing of the fact that the paper was at their door at the same time yesterday and the day before that and the day before that. They may also think nothing of the fact that, at the moment they bend down to pick it up, some of the stories in the print version have already been updated on their phones and tablets, and new stories have been added, too: the score of a double-overtime game that ended too late, or news out of India that broke overnight. And all of these stories, the total daily and nightly output from all the desks at the *Times* – news from Washington and Ukraine and Sacramento and St Louis and Staten Island and Mexico City, reviews of movies that open tomorrow and of TV shows that aired last night, opinion pieces, recipes, weekly sections on home design and science and real estate and style and books – feed a larger world of news that never stops consuming. The growing universe of digital news outlets includes a great many amalgamators, recyclers of other people's reporting. Some report their own stories, but it is the *Times* that provides by far the most coverage of the most subjects in the most reliable way. The *Times* is a monster, a sprawling organisation, the most influential print newspaper and digital news site in the world.

But it still makes most of its money by selling paper, and the paper on which tonight's edition is being printed arrived, as it does each week, from four different paper mills – two in Quebec, one in Ontario and one in Tennessee – where it was packaged into rolls large enough to serve as the business end of a steamroller: 1 000 kilograms each and nearly one and a half metres in diameter. Eighteen-wheelers carried them to a *Times* storage facility in the Bronx, where more trucks took twenty rolls each from there to the plant in Queens, where manned forklifts



¶ **Matt Boggie runs the *Times*' R&D Lab, which tries to peer into the future of news. One project: figuring out how to use drones for news-gathering in ways "that don't annoy anyone and don't get us sued".**

deposited each one in a four-storey warehouse that can hold 2 231 just like it. The rolls now sit stocked in eight rows on nine shelves, four deep, like soup cans in a grocery store for giants. Conveyor belts deliver them to the paper-handler area, where the rolls are flipped sideways and land with a deep boom, ready to be loaded into press reels that feed them through slits in the ceiling. The rolls of paper unspool on seven different presses that will each run for between six and eleven hours by the time Booth clocks out. A plant worker attaches the end of each roll to the start of the next using giant pieces of tape, so the press never has to stop.

In the plate room Sergei Primachenko waits for digital files of each page to arrive from the *Times*' midtown Manhattan headquarters, 15 kilometres to the west. (Ask Booth how often the editors there meet their deadlines and he will push his glasses down his nose and raise an eyebrow.) Primachenko seems to view many steps in the printing process as "mission critical". ("Having the precise amount of ink is mission critical.") Upon a file's arrival, a laser etches an image of the page on a piece of oxidised aluminium, which is then washed in a sugar-based chemical like a roll of film being developed. A different plate must be produced for each of the press's four colours – cyan, magenta, yellow and black – and

because a single page might be printed in a different form in various editions, the plant uses 3 000 plates to print some fifty pages each night.

From there the plates are locked on to the press, and ink is put to paper. The presses can print up to 80 000 papers per hour, and it's noisy as hell when Booth heads back out to the floor – the decibel level can reach 87, loud enough to cause hearing loss over time. The paper zips up from the basement, zigzags through the press – which applies ink that sticks only to the areas marked by the laser – then jets back towards the middle of the room, where half a dozen pressmen in ink-stained jumpsuits grab pages off the press so that they can stare intently at a millimetre-wide box in the top-left corner of the page. If the box is black everything is in order, but if there's a hint of cyan off one edge, the plate is out of register, and the page must be readjusted. By the time a page is deemed ready for public consumption – called “first good copy” – the plant is likely to have printed several thousand copies that go straight to the recycling bin.

Each page is simultaneously folded in half by a machine and sliced apart, to be raced along the kilometres of conveyor belts, as if Rube Goldberg had designed a clothing rack for the world's busiest dry cleaner. The goal of the machine, one of only three in the world, is to get each paper out the door without being touched by a human hand. Along the way, various inserters open each copy, deposit ads from department stores, stack papers into bundles of fifty, strap them with plastic binding – snap! snap! snap! – with a speed that would make a dominatrix blush, and pile them on pallets to be rolled on to *Times*-branded trucks, which start pulling away in an order scheduled to the minute, bound for one of fifty depots, where paperboys and girls and men and women will pick up this morning's *New York Times* more or less the same way Ernie Booth did twenty-eight years ago.

6:20 AM

A WEDNESDAY

1 **LYDIA POLGREEN OPENS HER EYES**, rolls over in her bed, and grabs her iPhone. Her mind is already several time zones ahead. Polgreen is the deputy editor of the *Times*' international desk, which used to be called the foreign desk until somebody pointed out that the *Times* has readers all over the world. (As Polgreen puts it, “Foreign to whom?”) She scrolls Twitter to see what's trending. She scans the apps and Web sites of the *Times*' competitors. She reads the many stories that some of her seventy-five foreign correspondents filed while she slept. Then she gets out of bed and makes coffee. She



Lydia POLGREEN

DEPUTY EDITOR,
INTERNATIONAL DESK



Bill DICKE

ASSISTANT EDITOR, NEWS DESK

needs to be at the *Times*' headquarters for a 9:40 conference call with the editors in Europe.

The *Times* is one of a dwindling number of media outlets willing to keep reporters in places where they aren't always wanted. Polgreen has worked as a correspondent in Senegal, South Africa and India and knows the importance of being looked after. Reporters assigned to a country for the first time are occasionally taken totally offline for months or even a year – no stories to file, no office to report to – so

that they can learn the language and culture, an expensive and extraordinary commitment by the *Times*. In addition to monitoring their stories, Polgreen must monitor the whereabouts and well-being of the reporters themselves. “If they disappear for a really long time, we'll definitely be like, ‘Hey, what's up?’”

Sometimes the *Times*' commitment to covering the entire world has dire consequences. In early 2012 Anthony Shadid, a *Times* correspondent who had won two Pulitzer Prizes for his coverage of Iraq, was in Syria for the uprising against President Bashar al-Assad. Shadid and *Times* photographer Tyler Hicks were in the country without the knowledge of the Syrian Government, having entered Syria at night across the mountainous border it shares with Turkey, which is strung with barbed wire for much of the 800 kilometres. They scrambled over a barbed-wire fence, and guides on horseback, arranged by Shadid through a network of smugglers, picked them up. On the way out a week later, Shadid suffered a severe asthma attack, leaned against a rock, and collapsed. Hicks administered CPR for thirty minutes, but Shadid never recovered. He was dead. When a local doctor was finally persuaded to arrive on the scene, Hicks picked up his friend's body, hoisted it into the doctor's pick-up, and took it back across the border into Turkey.

11:50 AM

ELECTION DAY



STACY COWLEY'S EYES MOVE AROUND her computer screen, bouncing be-tween the *Times* home page and a half-dozen open chat windows. There is pizza coming later because it's Election Day, and on Election Day at the *Times* there is free pizza.

“Election Day is like the High Holidays around here,” Cowley's colleague Michael Owen says.

Owen and Cowley are the morning producers of NYT Now, the *Times*' first mobile app that has a dedicated newsroom team around the clock. It launched last April. This job – running an app – is like a growing number of jobs at the *Times* in that it didn't exist six months ago. Owen, tall and reserved, and Cowley, with glasses and long dark hair and a well-caffeinated energy, sit near the paper's news editors – different creatures living in the same forest. While Owen perches at his standing desk scrolling the Web for what's making news, Cowley sits at her desktop using old-fashioned news judgment and modern technology – a program tells her in real time

how many people are clicking on any given story – to help determine what's worthy of keeping on the app this very second and what to replace with something more view-worthy. Bursts of text stream into her chat windows as editors jockey for position on the app. *Times* journalists communicate largely through a customised version of Gmail and a labyrinth of private chat rooms like these. "Until, like, six months ago we were literally communicating all day with AIM chat rooms," Cowley says. "Anyone in the world could have joined that chat room if they happened to find it."

Just after noon Cowley is greeted by a young man in jeans and a blazer who works for the *Times*' Interactive News Team, a group formed seven years ago to train and develop a team of "developer journalists", programmers who code tools for the newsroom's use. He has built a bit of code that will deliver live updates to the NYT Now app as election results pour in tonight. Cowley plugs it in to the app's content management system, hits refresh, and watches as... nothing happens. The developer exhales, sits back in his chair, opens a laptop and goes back to work.

"There's definitely a little MacGyvering happening here," Cowley says. "We're gluing the hamsters and the shoe-strings together to make this all work."

No one at the *Times* is under the illusion that producing the world's most ambitious print newspaper alone will be enough to keep the company afloat. In the third quarter of 2014, print advertising decreased by 5 per cent. But digital advertising was up more than 16 per cent, and there is an increasing willingness in every section of the paper to try anything. On the twenty-eighth floor of the paper's Manhattan headquarters, around the corner from the company lactation room, is the *Times*' R&D Lab, a huge, open room with completely white walls and views that stretch deep into New Jersey and ceilings high enough to accommodate a small squadron of drones sitting momentarily idle on a shelf. "The drones are for droning," Matt Boggie, the lab's director, says. He's been working with the company's legal department to find out how to use the drones for news gathering in ways "that don't annoy anyone and don't get us sued".

Boggie is preparing the lab for a visit from advertisers – he gives tours of the lab regularly to business associates, school groups, and the like – and walks through the space messing around with various prototypes. On one computer an earthquake tracker can compose news-alert summaries of a story based on seismographic data. Next to it a computer tracks various cycles – the life span of a fad, the spread of a virus – based on how often certain keywords appear in *Times* articles. In the middle of the room, a PlayStation controller has been hooked up to a Mac to display all the traffic coursing through the *Times*' website, with flying hexagons representing published stories and blinking



Lillie DREMEAUX

DEPUTY EDITOR, NEWS DESK



parabolas tracing visitors to the site. "I can't control it because I don't actually know how to use it," Boggie says. An assistant walks by and feeds a stack of papers into a shredder.

The R&D Lab opened nine years ago with the goal of looking three to five years into the future. (The *Times* declined to say how much it cost to build.) Marc Frons, the company's CIO, who oversees the lab, says he has no idea how people will interact with the *Times* in ten years, "whether it's on your wrist, or your forehead, or you take a pill, or it's a holographic contact lens, or a head-up display in your vehicle – or on your mirror in your bathroom". The lab explored E Ink before the Kindle even existed, was responsible for delivering the earliest versions of the paper's mobile news alerts, and helped the *Times* become the first publisher with an application on Google Glass. One of the lab's researchers recently designed a brooch programmed to light up whenever a topic is mentioned that matches something the wearer read about online that day. What good would that do, exactly? Boggie answers with enthusiasm, "We don't know yet!"

Steve Duenes, the graphics editor, is reviewing a series of thirty maps that illuminate the ongoing crisis in Ukraine. The blinds in his office begin to lower automatically. ("There's a little chimp," he says.) Duenes is tall, with close-cropped hair to match the militaristic fervour with which he pushes his department, which has grown rapidly in recent years. The *Times* employs approximately 1 300 journalists, a classification that now includes much more than writers, editors and photographers. There are videographers and developer-journalists and graphic designers, who insist that you not call them graphic designers. Every section of the paper has been affected by the Internet, but the graphics department is hardly recognisable from the days when, to accompany a story about Borneo, for example, it would simply produce a small black-and-white map of Borneo. Duenes's desk still produces traditional newspaper graphics, but it also now employs thirty-five people who have expertise in statistics, programming, cartography, 3D modelling, motion graphics, audio production or video editing. At the department's two long desks, designer Haeyoun Park combs through data on the racial breakdown of police forces – a story the graphics team reported without any instigation from print reporters – while nearby Matt Bloch is updating the paper's digital hurricane tracker. "Tis the season," he says.

3:10 PM STEVE DUENES, THE GRAPHICS EDITOR, IS REVIEWING A MONDAY



a series of thirty maps that illuminate the ongoing crisis in Ukraine. The blinds in his office begin to lower automatically. ("There's a little chimp," he says.) Duenes is tall, with close-cropped hair to match the militaristic fervour with which he pushes his department, which has grown rapidly in recent years. The *Times* employs approximately 1 300 journalists, a classification that now includes much more than writers, editors and photographers. There are videographers and developer-journalists and graphic designers, who insist that you not call them graphic designers. Every section of the paper has been affected by the Internet, but the graphics department is hardly recognisable from the days when, to accompany a story about Borneo, for example, it would simply produce a small black-and-white map of Borneo. Duenes's desk still produces traditional newspaper graphics, but it also now employs thirty-five people who have expertise in statistics, programming, cartography, 3D modelling, motion graphics, audio production or video editing. At the department's two long desks, designer Haeyoun Park combs through data on the racial breakdown of police forces – a story the graphics team reported without any instigation from print reporters – while nearby Matt Bloch is updating the paper's digital hurricane tracker. "Tis the season," he says.

1
A DAY IN THE LIFE
Clockwise, from top left: The page one meeting, an afternoon ritual; Ernie Booth, steward of the night-time presses; a mock-up of the next day's front page; an aluminium printing plate; pressman Steve McConnell; one of the machines that feeds paper through the ceiling to feed the presses upstairs.

5,5

KILOGRAMS

Weight of the 13 September 1987, Sunday edition of the *Times* – a record.

1 612

Number of pages in the 13 September 1987, Sunday edition, also a record.

27

Number of printing sites in the United States.

36

Number of printing sites in the rest of the world.

ADDITIONAL REPORTING BY TOVA CARLIN



A breaking-news event might require eight members of Duenes's team, who are otherwise free to focus on the kind of in-depth reporting for which the *Times*' print reporters are generally known. Last August a graphics editor who had been tracking police data for four years discovered that the New York Police Department had more or less ended its controversial stop-and-frisk policy, which some critics had described as racial profiling. This was news to the reporters on the Metro desk, and the editor there assigned a story to go along with the graphics department's analysis.

The story, and the graphic, ran on the front page.

4:00 PM TOM JOLLY IS TALKING INTO A SPEAKERPHONE. THE PAGE **A TUESDAY** one meeting is about to begin.

“Washington, are you there?”

The page one meeting used to be at 10 am, but now the 10 am meeting is simply called the news meeting because it covers so much more than what's going to be on page one the next morning. So now the page one meeting is at four o'clock, and it's four o'clock now.

Jolly, the paper's associate masthead editor – one of the most senior positions in the newsroom – is sitting at a large conference table surrounded by thirty editors in bright-green felt-covered chairs. For all the *Times*' investment in its digital momentum, page one of the daily print edition is still the most coveted space in *The New York Times*, and this conversation remains the paper's most sacred ritual.

Jolly worked at the *Times* for sixteen years before taking over the news desk, which means he's in charge of how the news is presented on every platform. He is dressed like a hip professor – blazer, cool glasses – as if attempting to bridge the gap between the paper's grey past and its digital future. To his left a screen is lowered to display both the Web and mobile front pages, which refresh constantly. Various smartphones rest on the table. One of Jolly's responsibilities is to decide when to send out a mobile alert to the 14 million people who have asked the *Times* to interrupt their lives when he thinks the news warrants it, one more way the sound of a newspaper landing on a driveway in the morning no longer heralds the arrival of the day's news. (“We've almost entirely gone away from paying attention to any print deadlines,” says Jason Stallman, the sports editor.)

Still, reporters want their stories on A1. Jolly goes around the room asking representatives from each section to state their case. It is a mostly polite debate – when the obituaries editor offers a remembrance of a yoga pioneer, a gruff male editor is ribbed for his surprising knowledge about the topic – but the editor from Washington isn't shy about butting in. Jolly turns over the floor to an editor from international, who has a piece about the ransom demanded by Islamic State militants for James Foley, the journalist who had recently been beheaded in Iraq. It's an obvious candidate for the paper's top story – front page, top-right corner – but some editors have concerns. “Are you talking about the other side of it?” says Ian Fisher, the paper's deputy executive editor and previously the paper's Rome bureau chief. “The Italians would always say, ‘If you'd only stop paying, they'd stop taking Italians.’”

Dean Baquet, the paper's top editor, is worried that revealing too much about captives still under Islamic State control might put their lives in danger.

“We're not identifying their names and the amount of money – we can talk about the sourcing,” the international editor says.

“Let's talk after the meeting,” Baquet says.

The *Times* is occasionally mocked for its staid and deliberate pace, but it is in moments like these that the seriousness with which it approaches every aspect of its operation becomes clearest. There are few organisations with the resources to spend such time and consideration on stories that aren't primed to go viral – though search-engine optimisation and other tricks of the digital age do receive plenty of consideration. When the conversation turns to a vivid story from Liberia, where Ebola has overtaken a particular neighbourhood in Monrovia, one editor proudly reports that she believes the *Times* is the only outlet with a reporter on the ground, which makes everyone happy until another editor says, “I think BuzzFeed actually has somebody there.” There is momentary silence.

The editors continue around the room. With Ebola and the Islamic State, plus the story pushed by the Washington editor and a national desk despatch from protests in Ferguson, page one is running out of space. A metro editor advocates a story on jury selection because it has “a cool interactive element”, while sports pitches a piece on conflicts of interest in the United States Tennis Association. Art is a consideration, so the lights are dimmed, and a photo editor cues up the day's best photographs on a projector: there are images of a bombing in Gaza, a portrait of Foley, and a series of pictures from a *Times* photographer embedded with a group of Kurdish soldiers in Iraq. Attorney General Eric Holder is in Ferguson, but the photo “is pretty boring”. The most arresting image is a Liberian soldier enforcing an Ebola quarantine with a rifle around his shoulder and a baton he is swinging in the direction of a young girl. The next day it will run across two-thirds of the front page.

After a moment's deliberation, Baquet announces that the last slot will go to the jury story, “so we don't have the world's grimmest page”. The room empties as editors depart to relay the news to their sections, while Baquet, Jolly and a group of designers stay behind to sketch out what the page might look like on a piece of paper. It is one of the few times that day anyone in the office uses a pencil.

6:00 PM ANDREW KEH IS ONE OF TWENTY REPORTERS IN **A WEDNESDAY** a beige-walled room in the bowels

of Madison Square Garden two hours before the New York Knicks basketball team tip off against the Dallas Mavericks, listening to Knicks coach Derek Fisher try to explain why his team is off to such a rotten start. Reporters shout questions about injuries and lineups while Keh stands to the

¶ Architect Renzo Piano designed the *Times*' headquarters in Manhattan, which opened in 2007. It's near Times Square, which was named after the paper a hundred years ago.

32,8

MILLION

Size of the *Times* mobile audience in November 2014. Half the digital audience uses mobile devices.

38,6

MILLION

15,6

MILLION

Total number of *Times* app downloads for smartphones and tablets, respectively, as of October 2014.



Dean BAQUET

EDITOR, THE WHOLE SHEBANG

side in an untucked checked shirt under a sweater, camouflage Nike sneakers, and black jeans with a reporter's notebook sticking out of the back pocket. Because tonight's game is starting late, Keh's editors have asked him to file a story before the first jump shot, so he's in the locker room hoping to talk to Tyson Chandler, the former Knick returning to face his old team. But when the locker room closes forty-five minutes before game time, Chandler still hasn't shown up. "We just wasted half an hour," Keh says.

Keh got his start covering high school hockey games for *The Scarsdale Inquirer*, a weekly newspaper in a suburb of New York, and joined the *Times* as a news clerk, making copies and answering phone calls. After Keh helped a sports reporter with legwork on a series of stories about steroids, the paper hired him as a beat reporter

□ ✕ □
*An editor used to ring a bell when
 the last page was sent to the printer
 and yell "Good night!" to a mostly
 empty newsroom. These days at
 midnight, the room is full of
 journalists. The bell is gone. #*

□ ✕ □

covering the New York Mets, and then the Brooklyn Nets. Now his home is the Garden. Keh has to be at the press conference and in the locker room "in case a fight breaks out", but the *Times* wants even its daily beat reporters to pursue ambitious stories. "We're trying to separate ourselves from every beat reporter who covers every groin strain," he says.

Even with a regular schedule of games, Keh's job is not regular at all. He missed a game a few weeks ago when he landed a strange scoop. With an assist from the *Times'* research department, he had got in touch with a woman in Santa Fe who owned the domain name Nets.com and had been demanding that the Brooklyn basketball team pay her a seven-figure fee for the URL. Keh's editor told him to get on the next flight to New Mexico, where he landed less than twenty-four hours later. The woman agreed to the interview on the condition that Keh complete the *Times* crossword puzzle with her, which he did.

At the Garden, Keh returns to the media room to write an early game story and finds Scott Cacciola, another *Times* reporter, at the next desk. Cacciola is on an assignment from Baquet, who had just watched a miserable Knicks game and wondered what the heck Phil Jackson, their legendary and newly hired president, was doing with the team. (The Knicks had, at the time, won five games

and lost 21.) "I'm supposed to stalk Phil," Cacciola says.

The game is a blowout – the Knicks lose by twenty – so Keh has plenty of time to file a second version of his story from his seat in the press box just after the buzzer before hustling downstairs for post-game interviews. After Fisher's press conference, Keh walks to the Knicks locker room, tweeting quotes from Fisher along the way. (The *Times* doesn't require reporters to tweet, but encourages it and offers classes.) In the locker room, Cacciola trawls for lesser Knicks players who might comment on Jackson while Keh waits for Carmelo Anthony, the team's star, who took forty-five minutes to shower and dress before showing up to talk.

Deadline looms, so Cacciola offers to record Anthony while Keh returns to his laptop. At 11:07 Keh's editor emails to say he needs the story in thirty-three minutes. The article Keh filed when the buzzer sounded was already posted on the paper's Web site twelve minutes ago after a quick edit by only one other set of eyeballs – there was a typo in the first sentence – and he plugs in his earphones to pull quotes from the interviews. Cacciola returns with the Anthony interview. At 11:42, two minutes past deadline, Keh files his story, calls the copy editors to make sure it arrived, closes his laptop, turns to Cacciola and says, "Let's get a beer."

8:30 PM

A WEDNESDAY

1 **BILL DICKE TAPS HIS DESK ANXIOUSLY, LEANS** towards his computer monitor and stares at the word "quarantine". He's trying to write a headline for a story on the arrival of Ebola in the United States, slated for tomorrow's front page. As assistant editor on the news desk, Dicke is among the last pair of eyes on the paper's front page and writes a lot of headlines. "Quaran-tine" is the best word, but at ten letters it has too many characters for a single column above the fold. The paper's first deadline of the night is in half an hour. Dicke frowns. "There are seven pages for foreign, eight for national, and we're supposed to close them in some kind of order before nine o'clock," mutters Dicke, who wears glasses and has a white beard. "None of the pages are even set." He rolls up the sleeves of his blue oxford shirt.

Facing Dicke in another cubicle, Lillie Dremeaux, a young woman with dark, curly hair, is considering what to do about a casualty. An activist in Israel was injured in an assassination attempt and Dremeaux, the deputy editor on the news desk, is trying to sort out where that story should fit among the 300 articles, videos, blog posts, op-eds and interactive features the *Times* will publish today. The *Times* Web site is the most coveted digital news space in the world, visited by 28 million unique users each month, nearly twice as many as *The Washington Post's*. On this day Isabel Kershner, a reporter in Jerusalem – seven hours ahead – has just filed a brief account of the shooting and the home page producer placed the story prominently. Dremeaux asks the photo editor if they have a picture of the victim – they don't – and, after considering it for less than ten seconds, tells the producer to bump the story down. "It certainly could explode into a war or something," Dremeaux says. "But he's not even dead yet."

The news desk is the centre and the highest expression of the *Times's* transformation from once-a-day newspaper to twenty-four-hour news outlet. It's both the slowest and the fastest part of the *Times* operation – a place where Dicke can spend a substantial portion of the evening considering a single word while Dremeaux makes decisions in seconds. Most of the *Times's* editorial staff is spread throughout three floors of the paper's headquarters, and news is on the third floor. (The headquarters is at 620 Eighth Avenue, just off Times Square, which was named after the newspaper opened there in 1904. In 2007, the paper moved into a glass-and-steel structure down the street, an audacious addition to the Manhattan skyline. The new building is sleek and

1

The newsrooms are packed with people and paper, but not as many people lately. At the end of 2014 a hundred editorial staffers took buyouts. But there are new jobs, too, in the R&D Lab, in app development, and in video production.

efficient – the window blinds rise and fall automatically based on the temperature inside.) Some desks are covered in old newspapers, others are clean and empty, a reminder that the *Times* operates in a post-recession, Internet-saturated media landscape where it still employs more reporters than any other major newspaper, but fewer than it once did. (After we had written this piece, the *Times* offered buyouts to one hundred newsroom staffers. Dicke took the offer.) A studio in which a video crew films short clips for the Web site and mobile editions looms over the middle of the newsroom.

As it turns out, Dicke doesn't need to fit "quarantine" on a single line after all. That night, the San Francisco Giants win the World Series, thanks to a performance by pitcher Madison Bumgarner so dominant that Tom Jolly decides to swap in that story and moves Ebola to an inside page with a wider berth for a headline. But Dicke has other problems and stares at his plus-size computer monitor, which is flipped 90 degrees so that he can see the digital page as if it were a newspaper in his hands. Every article on every page appears highlighted in blocks of green, yellow and red, signifying varying stages of completion and, thus, increasing levels of threat to Dicke's deadline. Elsewhere on the front page he changes the lead of one story because it's too long, then moves to another about how politics in Louisiana is becoming less eccentric. The starter headline reads, "Draining Colour From Politics in Louisiana," which Dicke doesn't care for. "It's not a very exciting headline, but it is sort of the point of the story," he says, copying and pasting the text into a blank document. "I'm gonna see if I can do any better." Five minutes later, out comes "Colourful Rogues Make Way for National Issues."

Dicke meets his first deadline – barely – but 9 pm is only the beginning. Deadline for the first local edition is 10:45, followed by another at midnight and a final call half an hour later. When Dicke finally packs up to leave just after 12:30 am, Lillie Dremeaux is still plotting out the next morning's home page and preparing to hand overnight duties to an editor in Hong Kong. In a previous era, after the last page was sent to the printer, an editor would ring a bell, walk towards the door, and yell "Good night!" to mostly no one, because there

2,5

MILLION

Average Sunday circulation, print and digital

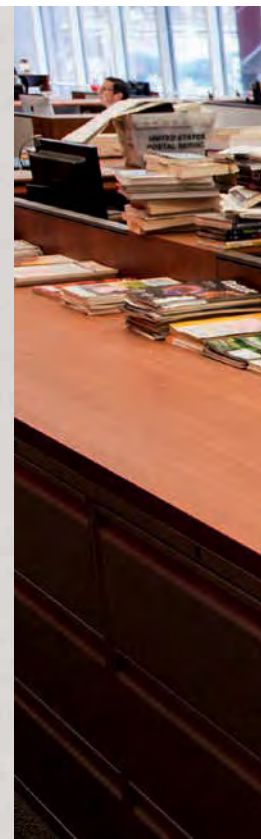
500

THOUSAND KILOGRAMS

380

THOUSAND KILOGRAMS

Amount of black and colour ink, respectively, used by the College Point Printing Facility in 2014.





was no one left to yell at. Dicke looks around at colleagues midshift, their eyes pinned to computer screens.

"We no longer do that," he says.

2:55 AM NATASHA SMITH AND MICHAEL GORDON PARK ON A **A SATURDAY** cobblestone street on the Brooklyn

1 waterfront as they do every morning. There is one of dozens of cars lining both sides of the street. They stand with a group of thirty or forty other deliverymen and women inside a loading dock waiting for one of Ernie Booth's eighty trucks to arrive. The Sunset Park Depot, as this cement room the size of a high school gym is known, is one of forty *Times* delivery centres throughout the New York area, and on this night it is responsible for the safe deposit of 12 559 copies across 215 different paper routes around the borough. Two hundred and thirty-three of those papers are the responsibility of Smith and Gordon, a husband-and-wife team that has driven a pair of routes together for the past three years. When the truck arrives at 3 am, the couple load five bundles of fifty papers each into a shopping cart and dump them on one of the many wooden tables in the room, where they combine the front and inside sections. Smith tosses one copy aside after spotting a rip, and watches out for missing sections – "I can tell just from the weight" – which could result in a complaint on the report card every carrier receives each morning. (They get paid 50 cents per paper.) Smith and Gordon shove each completed paper into a blue plastic bag and toss it into a pair of shopping carts. Deliverers are allowed to show up anytime – Smith

1 *Times* delivery trucks make more than eighty departures from the plant each night.



and Gordon arrive early, because late arrivals often get stuck with damaged copies – so long as they deliver their papers by 6:30 on weekdays and 8:30 on weekends. (In the suburbs, where commuters leave earlier, the weekday goal is 5:30.) The busiest hour in the depot is around 4 am and by 5:30 all the papers have been removed and the door is shut, leaving a lone worker to fill a shopping cart with the damaged and discarded copies left behind.

Smith and Gordon load their minivan and deliver all 233 papers in about ninety minutes. "Nothing like the cold to make you do it faster," says Smith, who's wearing a leopard-skin sweater and navy-blue beanie. On some blocks she and Gordon walk opposite sides of a street, tossing papers onto patios, while on others they split up – Gordon carries a shopping bag stuffed with papers as he walks down blocks with a high density of subscribers, while Smith drives sparser streets nearby. The longest stop is the five minutes it takes Smith to deliver six papers to individual apartments in a nursing home. One customer has asked her to hit his door with the paper so he knows it has arrived. Another customer's dog waits on the step and barks when the paper lands. At this moment, hundreds of thousands of copies of *The New York Times* are flying out of people's hands, a little action that starts a simultaneous morning ritual: a newspaper lands with a soft thud and eventually someone opens the door and picks it up, reads it, and knows what is happening in the world. **PM**

COMPILED BY THE EDITORS > popularmechanics@ramsaymedia.co.za



TESTED

LG G4

Picture perfect

BY LINDSEY SCHUTTERS



G4's low-light performance demonstrated in this 100% zoomed image of Azreal Vasili Victorious, lit by three overhead 5 W LEDs (original image, below left).

THIS, TO ME, IS THE BEST CAMERA ON A PHONE YOU CAN BUY RIGHT NOW. In terms of actual crispness, Samsung's Galaxy S6 camera edges slightly ahead with punchier colours. Nokia's all-conquering Lumia 1020 still offers a larger sensor. Why is the G4 superior then?

Although it shares 16 megapixels and an image sensor size with the similarly Sony-sourced S6 camera (1/2.6-inch), the G4 employs the Exmor IMX234 with native RAW image-making capabilities. Which,

in non-geek, means the image sensor has the inherent ability to give you unprocessed pictures; you'll see exactly what the sensor "saw" without any computer intervention. So, high-quality sensor? Check.

Then, the optical image stabilisation works on three axes instead of the two that most phone manufacturers use. Also, the lens is wide open at an aperture of f1.8 to let in a lot of light (Galaxy S6 is at f1.9).

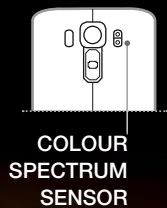
On the software side you get three shooting modes, with "manual" giving you control over the focus, white balance, contrast, shutter speed and exposure values. The only feature LG's latest flagship lacks when compared with a compact camera is optical zoom, but prime lenses are weird that way.

As a smartphone you get a 5,5-inch screen with a retina-singeing 2 560 x 1 440 (2K) resolution, 3 GB of RAM and a Snapdragon 808 processor that, admittedly, isn't the latest and greatest, but doesn't come with all of the overheating issues of the slightly more powerful 810 chipset. We liked the excellent camera experience, even getting a thrill from the 8MP selfie camera, but LG's bloated Android skin is sometimes a chore to navigate with odd slowdowns and stutters that smack of inefficient memory management. That's evidenced by duplicates appearing in the recent/open apps menu.

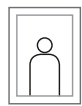
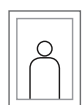
LG had a hit with the landmark G2, ignited the screen



SOME FEATURES:



x 2



FOUR CONSECUTIVE SHOTS



resolution wars with the popular G3 and has now firmly taken control of mobile photography with the G4. It isn't the best designed or most powerful phone on the market, but is still a superphone sporting the most advanced camera module (with all due respect to the amazing results Apple can get using a tiny 8 MP sensor) on a phone to date. You'll also get good value with a new G4 – like two back covers (leather and plastic) and a 100 GB Google Drive subscription valid for two years. R9 500; lg.com/za

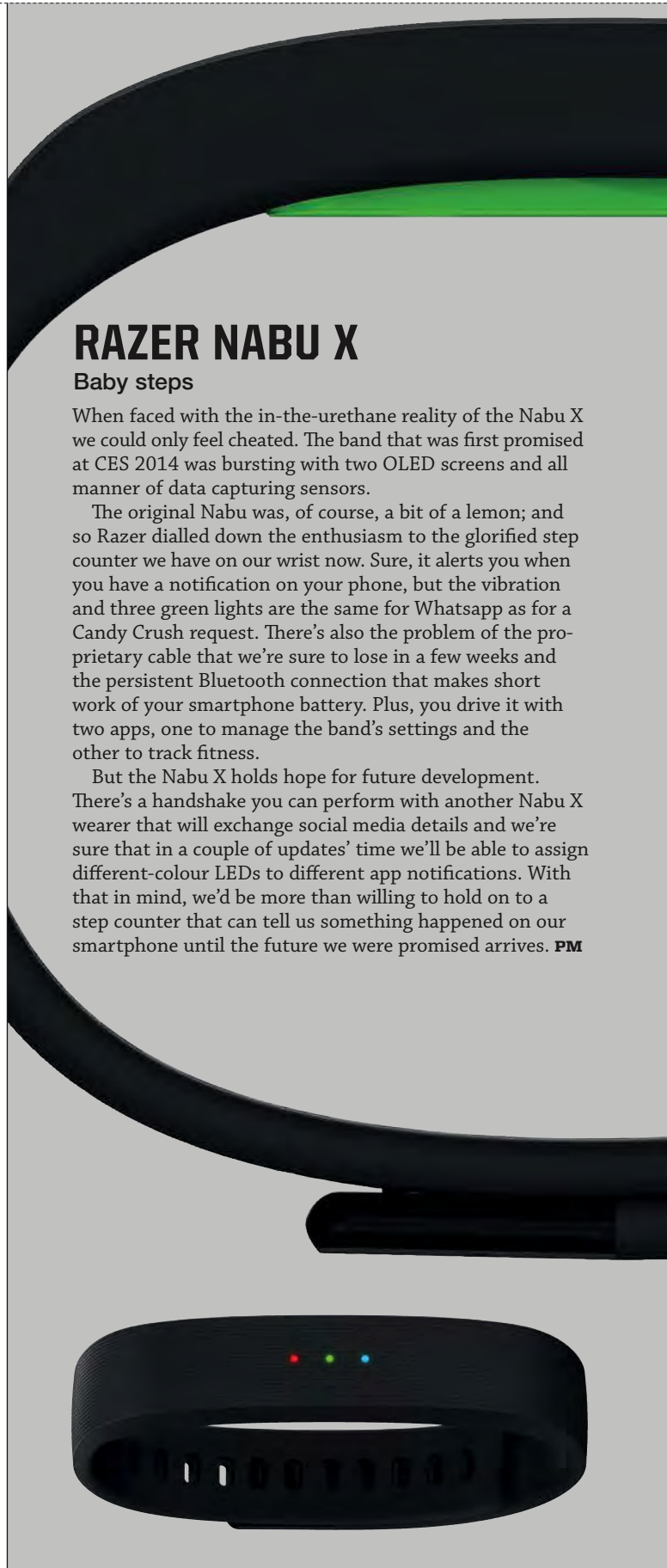
RAZER NABU X

Baby steps

When faced with the in-the-urethane reality of the Nabu X we could only feel cheated. The band that was first promised at CES 2014 was bursting with two OLED screens and all manner of data capturing sensors.

The original Nabu was, of course, a bit of a lemon; and so Razer dialled down the enthusiasm to the glorified step counter we have on our wrist now. Sure, it alerts you when you have a notification on your phone, but the vibration and three green lights are the same for Whatsapp as for a Candy Crush request. There's also the problem of the proprietary cable that we're sure to lose in a few weeks and the persistent Bluetooth connection that makes short work of your smartphone battery. Plus, you drive it with two apps, one to manage the band's settings and the other to track fitness.

But the Nabu X holds hope for future development. There's a handshake you can perform with another Nabu X wearer that will exchange social media details and we're sure that in a couple of updates' time we'll be able to assign different-colour LEDs to different app notifications. With that in mind, we'd be more than willing to hold on to a step counter that can tell us something happened on our smartphone until the future we were promised arrives. **PM**



SKILLS

INSIDE

- DISASSEMBLING A CHAINSAW
- REPAIR A DAMAGED FUEL LINE
- SHOP NOTES
- PROJECT: WATERSHOOTER
- PROJECT: STORAGE UNITS
- ASK ROY



DISASSEMBLY REPORT: CHAINSAW

MODEL: STIHL MS 362

PRODUCED:
VIRGINIA BEACH, VA.

DISASSEMBLED:
TORONTO

NOTES:

Jake Brandspigel, the Stihl product service supervisor who explained these parts to us, learnt his job the old-fashioned way, by repairing lawn mowers as a teen. While pursuing a bachelor's degree in mechanical engineering, he continued spending time in workshops. One day a Stihl representative on a routine visit called him out from under a mower and set him up for a post-university job. He's been at the company ever since.

NUMBER OF PARTS:

297

TIME TO DISASSEMBLE:
7 HOURS,
26 MINUTES,
40 SECONDS

- GUIDE BAR:** Supports and guides the chain, and also feeds it lubricant via two small holes that release bar oil from the engine's oil pump.
- SAW CHAIN:** The chain is what does the cutting, though it's actually more like shaving. Each link has a depth gauge that sets how deep it can reach into wood. One cutting surface, the side plate, slices down to the appropriate depth, and the other, the top plate, shaves wood away.

- CARBURETTOR:** Delivers a mixture of fuel and air to the engine. This one optimises the fuel-to-air ratio by continually changing the amount of fuel – in tests that last mere milliseconds.

- PISTON AND CYLINDER:** The chainsaw runs on a two-stroke engine: when the piston rises in the cylinder, it compresses fuel in the combustion chamber above it and creates a vacuum that pulls the next portion of fuel into the crankcase below. Combustion of the compressed fuel drives the piston back down, pushing exhaust out and forcing the fuel up into the combustion chamber for the next ignition.

- THROTTLE TRIGGER LOCKOUT:** Must be depressed before you can engage the throttle trigger to prevent Friday the 13th-worthy accidents.

- BRAKE BAND:** When you need to stop the chain immediately, the chain-brake safety feature tightens this band around the clutch drum, stalling the engine. The chain brake can be engaged in three ways: by releasing the throttle trigger

lockout, by pushing the hand guard forward, or if something jerks the saw, which is called kickback.

- REWIND STARTER:** When you pull the handle, a tensioned spring yanks the string back in. The resulting rotation engages the flywheel, turning the engine over.

- CENTRIFUGAL CLUTCH:** This allows the chain to remain still while the engine idles. It has two main parts: the inner shoes and the outer drum. The motor always turns the shoes, but at low speeds springs prevent the shoes from turning the drum. When the engine spins fast enough, centrifugal force overwhelms the springs and pushes them into the drum, pulling it and the chain along.

- MUFFLER:** Bolted to the side of the cylinder. Quiets what would otherwise be a very loud series of explosions, and contains superhot exhaust particles within a spark arrester.

- HAND GUARD:** More protection from Friday the 13th-worthy accidents.

– KEVIN DUPZYK

A PHOTOGRAPH BY TODD MCLELLAN



A TIP ON DIFFICULT CUTS FROM A CHAINSAW ARTIST

➔ *Loggers and firemen make straight cuts. A chainsaw artist, on the other hand, often needs to create complicated swerves and twists. To cut a curve, such as when felling a tree with a bore plunge cut or during delicate pruning work, Jack McEntire, who makes extremely detailed totem poles, animals and even human figures under the name Chainsaw Jack, recommends using a saw with higher torque and lower r/min, such as a Stihl, to prevent stalling.*



Junior Ryan Lucier, front, and three other students replace the fuel line on the Camaro Z/28.

THE KIDS IN THE GARAGE

How to strip, repair, repaint and rewire an old car with help from an after-school auto club. Part six of a six-month series.

WHEN THE FREEDOM HIGH SCHOOL Auto Club in Freedom, Wisconsin, finally installed new engines in the 1974 Oldsmobile Delta 88 and a 1981 Chevrolet Camaro Z/28 we've been watching them restore, Ryan Lucier, a 17-year-old junior, worked with three other students to mount a fuel line to the Camaro's underside (see instructions, right). Lucier, now in his third automotive class, took his first class last semester and realised he loved it within the first week. He immediately dropped his art elective and added another auto-shop course to his schedule. Next year he plans to sign up for at least one more. "It gives me something to look forward to in the day," he says. There are far worse things to say about high school.



THE ESSENTIAL SUMMER BUG REMOVER

My dad taught the Freedom class before me, and one of the tricks he used to share is that nothing brings back the shine of a car like a clay bar. It's just a hand-sized piece of clay that you can buy at any automotive supply store, but it works wonders, removing dirt and bugs embedded in the clear coat that remain after regular washing. Lubricate the car's surface with soapy water or spray wax, then scrub your front bumper or hood with the bar until the grit is gone. The clay should pick everything up, but it will dull the shine a bit, so afterward you'll have to wax and buff the surface. It's labour intensive, but the results are more than worth it.

— JAY ABITZ, FREEDOM HIGH AUTO INSTRUCTOR

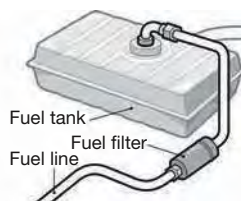
HOW TO

REPAIR A DAMAGED FUEL LINE

Tips from the Freedom High School Automotive Programme.

STEP ONE

Find the leak



If a rainbow-coloured spot appears on the driveway, you've got a fuel-line leak. To find it, jack up the vehicle and scan the steel fuel line that runs from your fuel tank to the engine for holes. There will be multiple sections: for example, between the fuel tank and the fuel filter and between the filter and the pump. Note, however, that fuel-line damage is usually caused by rust, so it is often found near the fittings that attach the line to the tank or the fuel filter. Use the location of the spot on the pavement to help you locate the damage.

STEP TWO

Remove the line



Detach the damaged section by unlatching the clasps that hold the line to the underside of the car. Using tape or chalk, mark the path of the line and where the clasps should go. Most late-model vehicles have brass fittings that connect sections of the fuel line, but some older vehicles use flexible hose instead. The former often require a tubing spanner and can be challenging to remove because of age and corrosion. When working on these, keep a can of penetrating oil such as handy.

STEP THREE

Buy a new fuel filter and line



Lots of shops bend their own fuel lines, but you can also buy pre-bent line. While you're at it, pick up a new fuel filter. The only information the store needs to help you find both of these items is your car's vehicle identification number, located on a label attached to the inner part of your door.

STEP FOUR

Install everything



If possible, ask a friend to hold the line (Ed: *love isn't always on time...*) while you attach it, then use the old clips or a set of new ones to secure it to the car's underside. Make sure to connect it to the same components it was connected to before. Also, bolt on the new fuel filter in the correct direction. You may have to note the direction before you remove the old one, or check for an arrow on the new filter. Now start your vehicle. Once fuel cycles through the system a few times, any problems should be obvious.

SHOP NOTES

Easy ways to do hard things



FOOD CARTONS USED TO IGNITE BRAAI

To quickly heat charcoal for a small camp grill, improvise a chimney from a cardboard milk carton. Dry it out, cut off the top, and cut ventilation holes around the bottom. Stuff in paper scraps, then pour self-starting charcoal on top. Light the paper. For an easy-to-pack fire starter for picnics, fill the egg cups of a cardboard egg carton with charcoal. When ready to grill, put lighter fluid on the carton and light it.



Wooden spoon solves kitchen quandaries



Without a thermometer, how can you know when frying oil has reached the required temperature? Inserting the handle of a wooden spoon into the heated oil provides an indication: slow-rising bubbles around the handle mean the oil is ready. When making pasta, a busy chef's pot often boils over. A wooden spoon balanced on the mouth of the pan retards the rising bubbles.

GUIDE TO WOOD GRAIN

The wide surface of a board and the growth rings of the tree it was cut from create an angle that is used to classify it.



FLAT-SAWN
Zero to 30 degrees. Cathedral face grain.



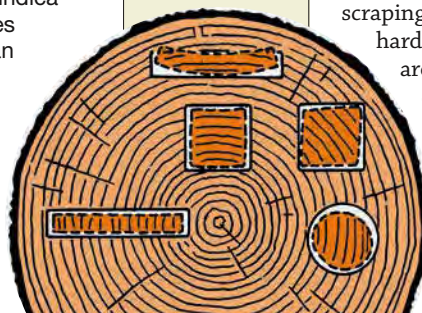
RIFT-SAWN
Thirty to 60 degrees. Straight face grain.



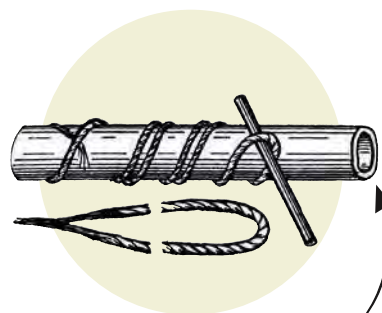
QUARTER-SAWN
Sixty to 90 degrees. Straight grain with flecking on face.

As wood dries, it shrinks in two dimensions: tangent to the growth rings and along their radius. Tangential shrinkage is more severe, so a board cut tangent to the rings is less stable. Here's how common cuts will shrink.

☐ fresh cut
☒ shrinking



FROM THE ARCHIVES (1908!)



Clever improvised pipe wrench

Improvise a pipe wrench with a length of rope and a metal bar, like a crowbar. When a pipe needs to be tightened, fold a rope in half and tie the ends together. Wrap the rope tightly around the pipe, tucking the tied end under one of the windings to hold it in place. Thread the metal bar through the loop at the other end of the rope. Twist the bar and the rope tightens and twists the pipe.

Copper wire helps wood screw grab in stripped hole

Remove the sheathing from a length of stranded copper wire. Insert the wire into the stripped hole and cut off the excess. Now insert the screw and begin driving it. It grabs, thanks to the wire.

Paint-tin key removes excess paint in hard-to-reach areas

A standard paint-tin key is not only more effective than a screwdriver at opening paint cans, but it also develops a burr on its end that is perfect for scraping excess paint from hard-to-reach places, like around the edges of a door-knob plate or escutcheon.

BACKYARD WATER SHOOTER!

A project to build with your children.

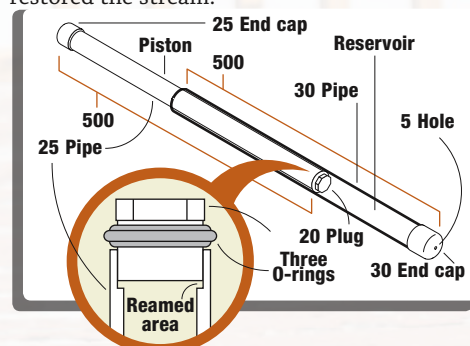
DIFFICULTY:	EASY	REASONABLE	HARD
	<div></div>	<div></div>	<div></div>
TIME: 1 hour	AGE: 12+		

PROJECT NOTES

OUR WATER CANNON is modelled after a version on the amazing website *Instructables.com*. The abuse-tolerant design means the cannon can be dropped, stepped on, and left outside. You'd have to try hard to break it.

Working with PVC pipe is straightforward. We used a mitre saw and an 80-tooth blade that cuts plastic and non-ferrous metal, but if you don't have that, you can just as easily use a simple backsaw and a plastic mitre box, a R200 hardware-store item. We experimented a bit with the O-rings, too. Our first attempt was too small, so we moved up. For lubricant we used WD-40, but you could also use water-proof silicone grease or even Vaseline.

After the first build, the spray was wide and wasn't shooting as far as we wanted it to. Then we noticed the burr on the inside of the nozzle that had formed when we drilled the hole. A couple of repeat runs through the hole with the bit removed the blockage easily and restored the stream.



Materials

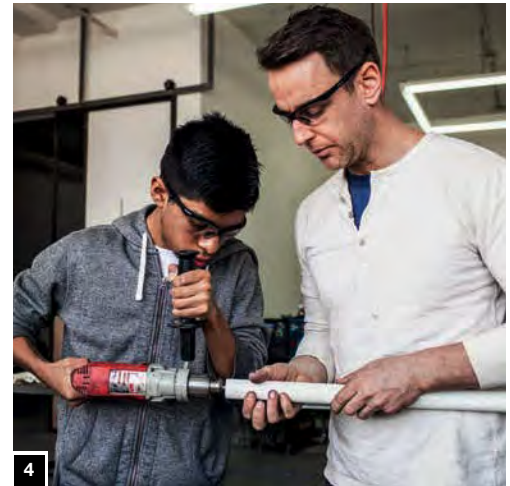
QTY	DESCRIPTION
1	25 mm PVC pipe, 500 mm long
1	30 mm PVC pipe, 500 mm long
1	25 mm PVC end cap
1	30 mm PVC end cap
1	20 mm PVC plug
	PVC primer and cement
1	5 mm drill bit
3	O-rings (25 mm outside diameter x 20 mm inside diameter x 3 mm thick)
	Lubricant such as WD-40 or Vaseline
	Bucket of water



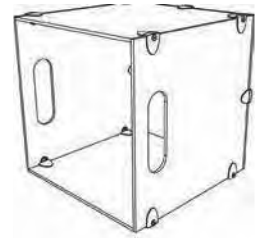
Instructions

● parent only
● parent and kid
● kid only

1. Use a 5 mm bit to drill a hole in the 30 mm end cap. Carefully run the bit through the hole in the opposite direction to remove any burrs that may have formed.
2. Apply pipe cement primer to the inside of the 30 mm end cap and the last 25 mm of the 30 mm barrel, followed by a thin film of cement.
3. Push the parts together and twist slightly to distribute the pipe cement evenly. Repeat steps two and three for the end cap on the 25 mm piston pipe.
4. Ream out the other end of the piston pipe with an abrasive sanding drum attached to your drill, until you've made enough room to fit the 20 mm pipe plug into the pipe. Approximately 6 mm of the plug's stem should extend out of the pipe.
5. Roll two O-rings onto the exposed part of the plug to form a base, then roll the third ring on so that it sits around the first two. (See diagram)
6. Apply a little lubricant to the O-rings. Pump the squirter gently a few times in a bucket of water to ensure that the rings are seated before taking the toy outside.



BOXING CLEVER



Modular storage cubes that use a novel fastening mechanism to provide plenty of storage and display options

Giving up all your worldly possessions is one way of cutting down on clutter. For one thing, there are plenty of things that most people would really rather keep. But where to store your junk... er, stuff?

Smart storage means finding a variety of solutions for stacking stuff. You need to hide items that are seldom used or messy-looking, perhaps putting on display others that are more aesthetically pleasing. And then there's the question of size.

Cubi, described by its designer Retief Krige of Stellenbosch, is a modular concept that makes a virtue of the one-size-fits-all approach. Ostensibly yet another on those seemingly endless variations on the humble box, it uses a novel, locally designed and patented fastening mechanism. If you detect something familiar about it, the inspiration for this project was our **DIY Challenge No 1: Construct something using a single sheet of plywood.**

"As a father of three, I'm familiar with the challenge of getting children to pack away their toys," says Krige. "Cubis are an easy solution. They are easy to manufacture, easy to construct, easy to modify and easy to use."

Light, sturdy and easy to pick up and place, these handy boxes are not just for storage, either. "Cubis are ideal for carrying stuff around, to make clutter disappear, to use as camping gear or to stack with the Cubi Double. You can chimney it to store wine, assemble it as a bookcase feature, turn it into a memory box for the kids or tidy up your garage."

The result is a deceptively simple box that can be augmented by adding wheels, handles, or any sort of hardware. It can even frame a sculptured artwork to be mounted on your wall.

A single board layout consists of 3 equal-size modular boxes that may be configured as you like. Wastage is limited as most of the sheet are used and the design layout includes handle cut-outs and locating holes for shelves.

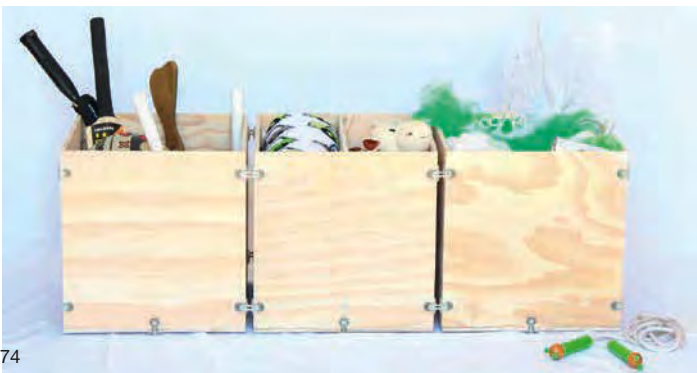
Joining it all up

Industrial designer Krige is one of the people behind the consultancy My Pocket Factory (mypocketfactory.co.za). That's where the fasteners used in this project originate.

Said to outperform typical knock-down fittings in joining strength, these fasteners have been developed specifically for digital CNC manufacturing. They enable thin panel boards to be joined without need for reinforcement. Another big advantage: they allow for 10 per cent variation in board thickness.

Curved surfaces can be produced by bending thin panels, using the pulling action of the hardware fasteners. Problems with round cutter and corner limitations in normal 2D profile joining are reduced or even eliminated.

The system is available to order online as pre-packed sets, with configurations that can be matched to your selected digital design product. The fitting covers the profile cut and therefore reduces edge finishing. There's also an external metal connector that allows joining or wall-mounting of the Cubi storage unit.





Materials

QTY. DESCRIPTION

- | | |
|---|--|
| 1 | sheet of 2,4 m x 1,2 m plywood, 6 mm or 9 mm thick |
|---|--|
- (a cutting list and layout are shown in the accompanying diagram)

Dimensions of one Cubi

Height: 368 mm
Length: 368 mm
Width: 368 mm

Optional features:

Side handles, middle shelves, wheels

Fasteners

Three fastener kits from My Pocket Factory (available online from www.mypocketfactory.co.za). Each fastener kit includes 12 basic fittings, 12 corner fittings, 4 connecting plates and one Allen key. You will need three kits, one for each Cubi.

Instructions

Step 1: CUT YOUR BOARD

Cut the panels using a jigsaw or send your .dxf file to a friendly CNC-router or laser cutter. (Search the Internet for local fabbers to assist you in cutting the components). The .dxf file can be downloaded at www.mypocketfactory.co.za or email popularmechanics@ramsay-media.co.za

Step 2: SAND EACH COMPONENT

Sand the cut edges down with a hand sanding pad (180 – 200 grit) to a soft and smooth surface.

Step 3: SURFACE TREATMENT

Apply a penetrating wax or sealant to all the components. You might want to add some stain into the basic sealant to make the end product more colourful or to match this with your surrounding interior.

Step 4: ADD THE FASTENERS

Follow the instruction sheet and clip your fasteners to each panel.

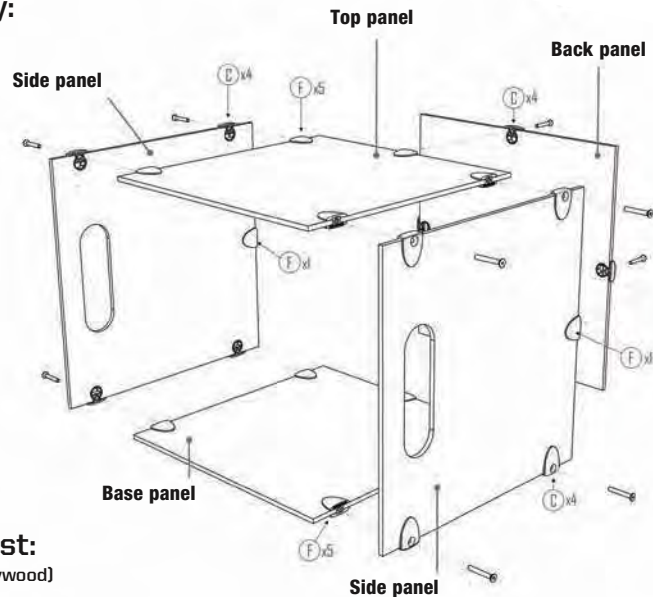
Step 5: ASSEMBLY

First, assemble each individual Cubi with its side, top and back panels as shown in the instruction sheet.

Once you have the three Cubis together, you can start planning your configuration. Use the metal connecting plates to connect the Cubis to one another.

PM

Assembly:



Cutting list:

(using 9 mm plywood)



Sides x6 pieces, 368 mm wide x 359 mm high



Sides x6 pieces, 350 mm wide x 359 mm high

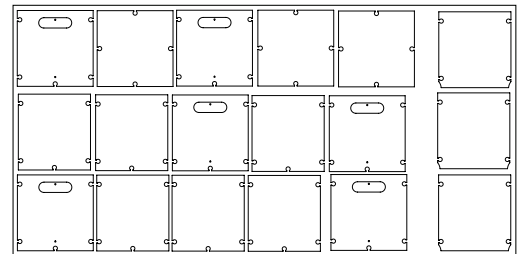


Base x3 pieces, 368 mm square



Shelves x3 pieces, 350 mm wide x 359 mm high

Layout: (sheet plywood 2,4 m x 1,2 m)



PM Home Workshop Challenge No. 3

Accept the **PM Home Workshop Challenge** and a **Makita DHS710 Cordless Circular Saw hamper**, valued at **R8 000**, could be yours.

(Included in the prize are a **Makita DHS710 circular saw**, two x 3,0 Ah **Makita lithium-ion batteries** (BL1830 recharge time is 22 minutes per battery) and a **Makita compact fast charger** (DC18RC).)

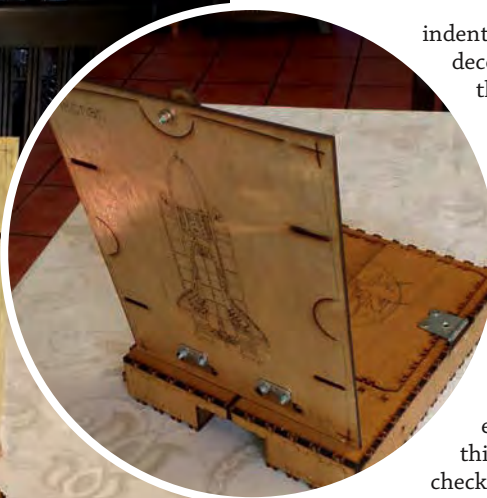


THE THEME: UNPLUGGED

It's load shedding and you're left with 2½ hours of downtime. Or... you could complete a winning project. **THE CHALLENGE:** A project that, as far as possible, uses no AC mains power directly to design and build. Battery-operated rechargeable tools are fine, as are hand tools, of course. You score extra brownie points for a project that can be completed in 2½ hours, that uses no AC mains power *anywhere* in its timeline (including production of the raw materials) and that mitigates the effects of load shedding.

Email your plans and a picture of the results to popularmechanics@ramsaymedia.co.za by 21 August, 2015.

For full competition rules, see www.popularmechanics.co.za/workshopchallenge



indentations between the joints, purely for decorative purposes. The laser doesn't care for the extra effort. But hey, it looks amazing!

Making plywood boxes with regular finger joints on a laser cutter or CNC mill is old hat by now. Web sites like www.maker-case.com will help you design a laser cut case with finger joints in seconds.

Once all the parts are drawn, a file is created for the laser cutting house. I exported the 2D picture to industry standard DXF format. The laser will follow the contours of the lines and vary its power to engrave or cut. (For the case's engraved NASA logo, a simple way to do this is to use two colours. Just be sure to check with the laser cut operator beforehand.)

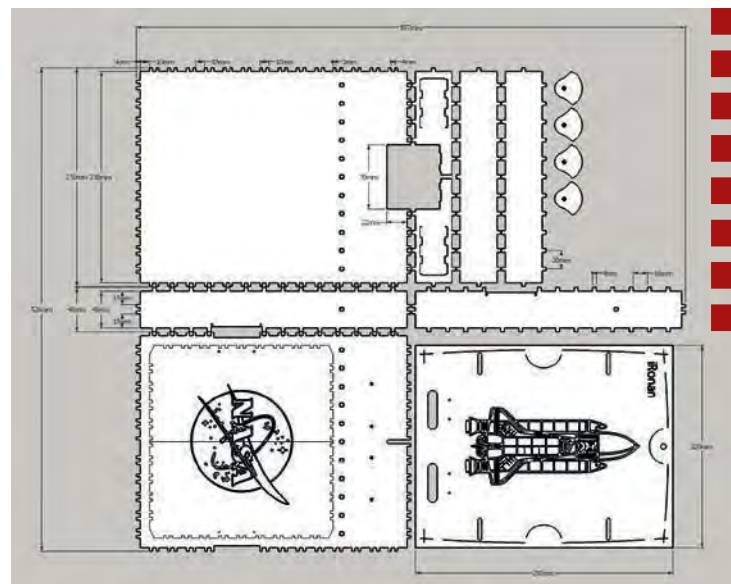
I used a free tool called InkScape to inspect and modify my files before sending them off for cutting. InkScape has a very nice trick up its sleeve called "edge tracing". I got the NASA logo from the Internet, fed it to InkScape and traced it around the edges using the trace tool. After a little bit of clean-up I had a DXF vector format file the laser cutter would understand from the original raster picture. Lasers cut in paths, or vectors like light sabres, and don't like to hang around big areas of dots (raster) too long. It is important to try to imagine how the laser will be cutting the wood and prepare the paths accordingly.

You generally pay for the volume of the material as well as the laser's cutting time; it is worth laying out the parts to save on both. My fancy joints ended up costing more than they should have because, although the laser can cut a finger joint for two pieces in one cut, my design requires twice the cutting time. So beware.

ASSEMBLY

There isn't much to say about assembly, because it builds like a 3D puzzle. I advise attaching top hinges when you glue the top panel, because the nuts are difficult to get to through the hole in the back. The rear compartment is for the wall charger and extra cables and perhaps a power pack if needed. The cable threads through the slot at the top. Incidentally, a piece of 10 mm cable trunking fits and holds the tablet perfectly at the bottom.

● Go to popularmechanics.co.za for full constructional details, diagrams and design files.



WE HAVE LIFT-OFF

At the start of the 2015 academic year, Ronan Shepherd's school was among those brave ones adopting tablets to replace textbooks. For Workshop Challenge No. 1, his dad Rudie designed a hardy box to protect the tablet. As Ronan has aspirations of becoming a NASA astronaut, it was a good excuse to incorporate some inspirational images on the box. "I guess it didn't really need deployable solar panels, but over-engineering is fun!" says Rudie. Here is his story.

Some might argue that a laser cutter is not a conventional tool in the home workshop, but I will argue that the humble scroll saw was also not commonly available to makers until quite recently, either. The modern maker needs a new array of skills and tools in the form of Computer Aided Design, laser cutters and 3D printers to bring new ideas to life not possible before. Maker spaces all over the country and indeed the world are making it easy to get access to these tools.

Like all woodworking designs should, this one started with a sketch. I played around with the design using Trimble (ex Google) Sketchup to draw the 3D model on my computer.

The idea with 3D modelling is to draw the profiles in 2D and then extrude the parts to the thickness of the material – 4 mm ply in this case. The 3D part is turned into what is called a "component", which is then used to assemble the box in virtual 3D.

The laser cutter will cut around the edges of a 2D line drawing. It is even possible to create a sketch with a pencil and paper and have that laser cut, but it is mighty useful to build the box in virtual 3D space to see if everything fits.

I used an unconventional type of bridle joint to leave 10 mm



Popular Mechanics

12 ISSUES FOR ONLY **R314**

SUBSCRIBE & SAVE 25%

You'll also receive a Dash 7 Quick Change Multi Bit Screwdriver worth R110 **FREE!**

No need to dig around in your toolbox to find the right screwdriver head in the right size: the DASH 7 comes as standard with 7 quarter-inch (6 mm) Hex Powerbits. Although compact, it's still a versatile, no-nonsense tool, with anodised shank and solid handle for extra durability.

PLUS FREE DIGITAL SUBSCRIPTION!

To extend your annual subscription for only R272 and receive all the benefits of the above offer, simply call 0860 100 205, quoting 15/08/SP/PM

**HOW TO
SUBSCRIBE**



[www.popularmechanics.co.za/
subscribe](http://www.popularmechanics.co.za/subscribe)



subs@ramsaymedia.co.za



'POP' to 32698
R1,50 per SMS



0860 100 205 tel
0866 704 101 fax

This offer closes 31 August 2015 and applies to print subscribers with a South African address only. Stock of the gift is subject to availability and while stocks last. The colour of the gift that you receive will be selected at random and may not be specified. Print subscribers can claim a FREE digital version – just contact us to confirm the e-mail address for the link. For foreign rates and other great offers, visit www.magsathome.co.za

POPULAR MECHANICS' senior home editor solves your most pressing problems.

BY ROY BERENDSOHN



Q We have a nice cedar picnic table and bench set, but the tabletop is weathered and there are food and beer stains. The benches also need to be refinished. Can you give us some tips?

A This is pretty straightforward. Begin with an application of an exterior wood cleaner that contains oxalic acid (bleach), such as Woodoc Wood Reviver. Scrub the tabletop and benches with a coarse synthetic brush, being careful not to score the surfaces. You can use a putty knife or a painter's 5-in-1 tool (a hook-shaped putty knife) to remove any junk that's built up between boards. Now rinse everything and let it all dry.

Next, sand off splinters and flatten dents with 120-grit sandpaper. Brush off any dust and gently wipe the surface with a tack cloth (a sticky piece of cheesecloth sold in the paint-supply aisle of hardware stores and home centres). The last step before refinishing is to replace any rusty screws or bolts with some made of hot-dipped galvanised steel. These will have a thick zinc coating that provides longer-lasting

corrosion protection than the whisper-thin plating of zinc or cadmium you find on the bolts and wood screws that come in most home centre bins. You can get hot-dipped galvanised fasteners on the Web or from old-fashioned hardware stores or industrial supply houses.

Finally, apply your finish. A semitransparent stain would be a good choice in that it will provide protection, but also allow some of the wood grain to show through. Using a synthetic brush, apply the finish down the length of each board without stopping, so you don't get lap marks. If the picnic table sees harsh Sun, you may want to apply two coats and reapply the stain every two to three years.

Q When my electrician brother came over to help me with some projects around the house, I noticed he makes holes in drywall

with an awl, not a drill. When I asked him why, he just said, "It's better." Is it?

A I think so. Contractors will often pack a heavy-duty awl with a full-length steel shank that's designed to be tapped with a hammer. A few light taps is all it takes to put a hole in 12 mm or even 25 mm drywall, and the awl's tapered shank will allow you to make holes of varying sizes.

Why is it better? It creates almost no dust and it's useful for other unusual jobs, like digging out rusty staples. Also: it never needs to be recharged.

Q Our house has tiny black spots on its siding, and we've been told that this is caused by a fungus that grows in our flower bed's wood mulch. Is this true?

A Yes. The spots are spores launched by tiny organisms known as artillery, shotgun, or cannonball fungus (*Sphaerobolus stellatus*). The spores stick to siding, cars and lawn furniture and are impossible to remove without damaging the surface. They'll weather away eventually. To control the fungus, turn the mulch weekly with a garden rake. This disturbs the fungi formation and breaks the mulch down more quickly, making it a less attractive food source.



TOOL OF THE MONTH

THE SILVER MARKER

When I started re-modelling a 1950's home a couple years ago, I needed to make marks on rusty metal, cast-iron pipe, tile and lumber so age-darkened it was nearly black. After a few annoying misfires with carpenter's pencils and pens, I came across a silver marker. It was visible in low light and glaring sunshine on just about any colour surface. I suppose I could have just bought a whole pack in fluorescent orange, green, white and black. If I ever remember to pick some up while I'm in an art supply store, I might do just that. Then again, I have enough to carry when I go on a job. A single silver marker fits in my pocket. **PM**



PHOTOGRAPH BY JAMES WORRELL



SPONSORED BY
Mercedes-Benz Vans

GAUTENG *Getaway* SHOW 2015

Unlocking your travel dreams

28-30 AUGUST 2015

FRIDAY 10AM-6PM • SATURDAY 9AM-6PM • SUNDAY 9AM-5PM
TICKETPRO DOME, NORTHRIDING.

Tickets available online or at the gates.

Adults R70, Pensioners and students R40, Kids 12 and under free.

Family pass (family of four) R150, Weekend Pass R150



WIN ONE OF TWO CRUISING HOLIDAYS COURTESY OF
CRUISEABOUT AND MSC CRUISES TO THE VALUE OF R100 000!

getawayshow.co.za


cruiseabout
The Cruising Specialists


MSC
CRUISES
The Mediterranean way of life


GAUTENG
It starts here.

The Star

SATURDAYStar



Mercedes-Benz
Vans. Born to run.

UPGRADE

AVIATORE VELOCE *Espresso magnifico*

Paolo Mastrogiuseppe is the kind of name you'd expect of a designer of exotic, handcrafted espresso makers. What you might not expect: Mastrogiuseppe is based in Bedfordview, Johannesburg. For the past three years his Espresso Veloce coffee machines in the shape of handcrafted half-scale Formula One engines have enchanted international collectors.

His latest creation, the Aviatore Veloce, does something similar – with a quarter-scale military jet engine. As well as being exquisitely crafted and detailed, it apparently makes coffee, tea or boils water.

The Aviatore Veloce is an exact recreation of a prototype that was never put into production during the Cold War era. Although true to its aerospace origins, the Aviatore has been tested to ensure that it complies with global health and electrical safety regulations.

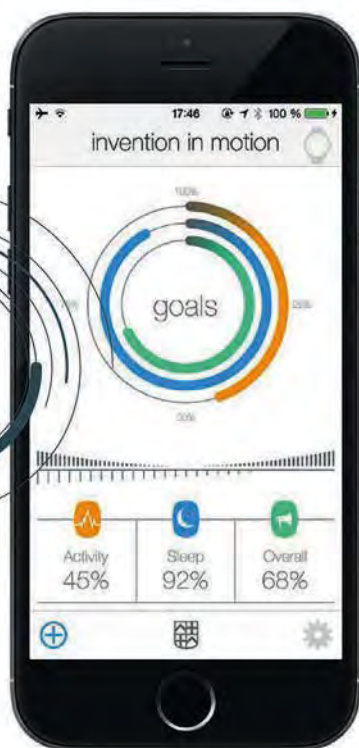
The sliding engine cowl or turbine shell, moved apart to begin preparing your beverage, in real life form the basis of the reverse thrusters on the full-size engine.

“What makes these quarter-scale Aviatore Veloce units so special is that the turbine shells are metal spun from authentic alloys that are used for the fuselage skin on commercial jets. It's very high end stuff and a nightmare to form,” says Mastrogiuseppe. The laser-cut outer shells are produced by metal spinning and the machine as a whole is made up of 300 components, many of them imported. The motor and gearbox that drive the turbine blades on the engine have built-in slip clutches as a safety precaution, stopping the turbine blades immediately as there is minimal torque on the spinning shaft.

By the way, the Aviatore Veloce uses no commercial coffee-machine components; everything is specially made for it. The Aviatore Veloce sells for R165 000 to R270 000; the Espresso Veloce engine coffee machines sell for between R85000 to R225 000.

Find out more: espressoveloce.com





FREDERIQUE CONSTANT HOROLOGICAL SMARTWATCH

Track your activity in style

Smart as the typical high-end sportswatch, smartwatch or activity tracker may be, it sits rather awkwardly alongside a jewelled cufflink or the soft leather-clad steering wheel of a pedigreed Italian sports car. Because what you wear on your wrist makes a statement, the Frederique Constant Swiss Horological Smartwatch gives the wearer the best of both worlds: Silicon Valley meets Switzerland. Although made in Switzerland, this handcrafted masterpiece is powered by MotionX technology from the US West Coast. It can connect to your smartphone via the MotionX-365 app, but is able to function autonomously as well because of its built-in sensors.

A first in the high end of the market, this is no cheesy analogue dial that flips up to reveal a digital display. It's an honest-to-goodness Horologe from a blueblood manufacturer that's fit to stand comparison with the timepieces typical of this part of the world. The required design, firmware, apps and cloud infrastructure that make up the MotionX Horological Smartwatch are bought in from a Geneva-based company, too.

Because of the smartwatch's energy-efficient design there's no recharge, as with regular mechanical watches. In typical use a replacement watch battery will be needed every 2 to 3 years.

Displaying activity is fairly straightforward. The two hands of the small multifunctional dial show percentage of activity on a 0-100 scale and indicate Sleep mode by pointing to a Moon icon.

Although it's outwardly classical and traditional, the smartwatch incorporates more than 50 patents (and as many pending) relating to horology, sensor fusion and biomechanics. It's based on the same Fullpower ecosystem that drives drives wearable solutions for brands from Nike to Mondaine. All the electronics are mounted in a single module with over-the-air upgrades.

Currently, its abilities don't go much beyond typical lifestyle activity tracker functions. That means, essentially tracking activity

ALWAYS ON TIME
AND DATE
MotionX®
ACTIVITY TRACKING

SLEEPTRACKER®
SLEEP MONITORING

SLEEP CYCLE ALARMS

GET-ACTIVE ALERTS

ADAPTIVE COACHING

2+ YEARS BATTERY LIFE

MotionX® CLOUD BACKUP
AND RESTORE



such as walking and running, as well as sleep patterns. Frederique Constant are understandably cagey about possible developments, beyond revealing that they have a five-year roadmap that they prefer to keep confidential.

Price: R16 999.

Find out more: picotandmoss.co.za

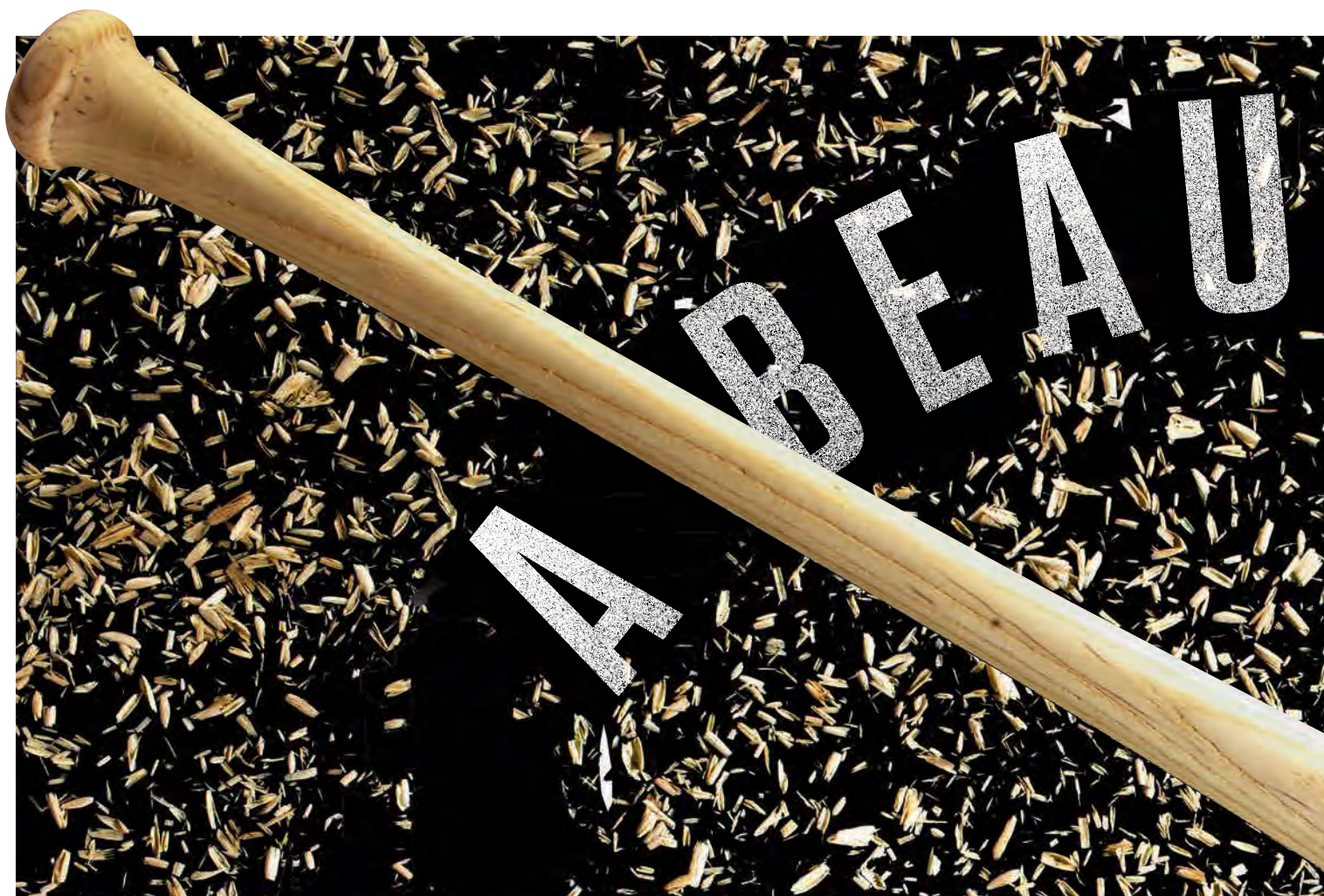
WITHINGS ACTIVITÉ

The affordable option

The Withings Activité watch is aimed at a broad market. Also Swiss-made, it's water-resistant to 50 metres, too, so swimming comes into the picture. Lifespan of the user-replaceable battery is quoted at around 8 months. Features include automatic time zone changes and a Health Mate smartphone app via Bluetooth. There's no need for dedicated buttons: simply tapping it will swap between modes. Price: about R5 500 at the Orange store.

Find out more: withings.com/active

PM



A B E A U

THE LOUISVILLE SLUGGER

COMPANY:
Hillerich & Bradsby

LOCATION:
Louisville, Kentucky

FOUNDED:
1884

Joey Votto, the power-hitting first baseman for the Cincinnati Reds, specifically requests straight growth rings. In fact, he wants eight growth rings per 25 mm on the maple billets that will become his bats, and those rings must be perfectly linear from end to end. Of the million 75 mm-diameter billets that Hillerich & Bradsby, the makers of the Louisville Slugger, process each year for Major League Baseball players alike, fewer than 2 000 will meet the tight requirements to become a bat that satisfies Votto's demands. In all, only about 80 000 of those million billets will wind up fulfilling pro orders.

Bobby Hillerich, a fifth-generation woodworker and fourth-generation bat-maker – the son of the founding Hillerich turned the family woodworking business

into a baseball bat company in 1884 – oversees the wood-bat manufacturing for Slugger. He'll send photos of the selected billets over to Votto's people for his approval before they're turned. That kind of close development of custom bats for MLB players is a long-standing tradition between the company and the sport. When Ted Williams was the greatest hitter in the game, he used to come through the factory in Louisville and slip ten bucks to the guy who turned the wood, asking him to set aside certain pieces. Today Danny Lockett, who's been turning professional bats at Slugger for 45 years, makes the final decision on which billets match the demands of which players. A baseball player's request is usually born more from superstition and feel rather than any scientific or statistical reasoning, but the company

abides. Some guys like pin knots in the grain, others like a wide grain. Younger players prefer the density of maple, traditionalists go for the flexibility of ash. Lockett turns the bats in a CNC lathe programmed with over 2 200 bat styles, all developed with the major league players.

Hillerich gets to the factory every morning at five to get the machines running in time for production to start at six. He's always moving around the production floor watching over the machines from his great-grandfather's day working beside the modern equipment. Both the old and new are part of a process that elevates a piece of sports gear to a vital tool of the master – whether that's Ted Williams, Joey Votto, or you, in your Tuesday-night league – who will wield it at home plate.

– MATT GOULET

PM

TIFUL TING



PHOTOGRAPH BY JEFFREY WESTBROOK





LEARNING

TO FLY

3

THE LANDING

•
•

MANY PILOTS WILL TELL YOU
LANDING IS THE HARDEST PART.
IT IS.

BY

JOSHUA
FERRIS

PHOTOGRAPHS BY

DANIEL SHEA

BY THEN I WAS ABLE TO KEEP THE PLANE STEADY

as we raced down the centreline. I was able to climb out in a coordinated and measured way, searching the sky for traffic, until I hit our cruising altitude. By then I could arrest our climb with forward pressure on the yoke – a modest achievement as piloting goes, but one that really pleased me. A climbing plane wants to keep climbing, you see, and a hard nudge on the stick implies a willful hand and a made-up mind. I acted with authority and know-how to keep the plane in line, and on that day I remember feeling that at last I had command over the single-prop Piper Cherokee we called Six-Two Romeo.

By then I also knew how to keep our altitude steady, and how to let turbulence wash over the airplane without micromanaging the stick. And I knew how to pull the engine back from the red line when it started running hot. I knew how to lean (or thin out) the mixture upon reaching our cruising altitude and all the rest of the cruise checklist. I knew how to spot Greenwood Lake from 2 500 feet, that blue slit of water with its lonely eye of land. I knew how to do clearing turns over the practice area before I began my manoeuvres, and I knew how to do my manoeuvres.

My manoeuvres were not perfect, and my navigation was not perfect, and my communication with air traffic control was not perfect. I might not say this or that correctly, and I could flub the protocol with the best of them. But by then I knew that, however formal and stern air traffic controllers might seem, they allowed for honest mistakes.

And by then I knew a bit more about the man next to me. Tom Fischer and I had been inside the tight confines of Six-Two Romeo for many hours together, on long days of blinding heat and short afternoons of freezing cold, and though I had tried to end his life in any number of interesting ways, he never took it personally. Nothing I did in the air rattled him. He was like the man who enters a snake pit or lion's den and has a calming effect on all the savagery.

Tom kept his hands near the controls, especially during critical moments, but by then, he was just as likely to go quiet and stare out the window for traffic while I did what was necessary to pilot the plane. Those long stretches of silence as we cruised over the pine forests of New Jersey were very companionable. There was the rock quarry that looked at once like a pulled tooth and an entire mouth of molars, and there were the swimming pools and tennis courts of the rich, and there was the heavy swathe of power lines like a scar upon the Earth. These casual moments gave me a foretaste of the silence that would attend my first solo flight – the prospect of which, in idle moments, terrified me. But if it was like this, I thought, there was no reason to be scared. My confidence grew every time Tom went silent.

O

ne day in October, we came in from the practice area north of Greenwood Lake and reported our approach to Caldwell Tower. I had been taking flying lessons for about ten weeks. A kilometre out, we joined the pattern on the downwind. The downwind is the first of three legs that finally puts you on the runway. Abeam the numbers, I reduced power and began to descend.

At 900 feet, I made my base turn into a modest tailwind. The view outside the windscreen was of a broad hillside blanketed by trees and toothpicked by signal towers and power lines. The runway was off to my right. I pitched for the right airspeed and trimmed the yoke. At 700 feet and falling, I turned base to final.

As the wing dipped heading into that final turn, the windscreen filled with earth, trees, houses. Trees et al have the power to terrify during a descent, when you seem to be heading straight for them belly-first. But by then I could anticipate and manage that fear. What I was seeing was the naturally occurring phenomenon of a customary landing. However, it takes a lot not to nose up, out of instinct, to put a little distance between your ass and the Earth. By then I was trained not to nose up – “Don’t get pitchy,” Tom liked to warn. But bad habits are hard to break.

Runway 22 was ahead of me now, just past the highway. To my dismay, I discovered that I was way off the centreline. I’d allowed myself to be blown off-course by the tailwind. I needed to crab over. Meanwhile I was falling more than a thousand feet per minute, and something was off. We were sinking.

We were sinking over I-80 and the Wayne Town Centre shopping mall. The pines below me were whipping past like green skewers of death. The rooftops were rearing up, gaining compactness and detail.

“We’re sinking, Tom.”

“You got pitchy,” he said. “And now your airspeed is off.”

I had done my best not to nose up at the sight of all those fast-approaching trees, but the facts were the facts. If we were sinking, I had nosed up.

“Add power now,” Tom said.

I heard the urgency in his voice. I reached for the throttle.

In Six-Two Romeo, the throttle works two ways: by pressing it in and out, like a foosball handle, for greater thrust; and by twisting the knob, which yields a more refined dose. At that moment I needed to really punch it, but for some reason, I just gave a pansy little twist. What’s worse, I went the wrong way. We began to sink even faster.

“When I say add power, I don’t mean little twists. I mean add power.”

I punched in the power. It restored our lift and we climbed away from the

- Joshua Ferris is the author of three novels, including *Then We Came to the End*, a finalist for the National Book Award, and *To Rise Again at a Decent Hour*, nominated for the prestigious Man Booker Prize in the first year American writers were eligible to receive it. Look for the final instalment of “Learning to Fly” in our next issue.

trees and the rooftops. But we still had to land.

"Should I go around?"

"Going around is always an option," he said.

This was one of Tom's refrains. He liked to tell the cautionary tale of a pilot who crashed at Caldwell trying to land when she should have gone around. "Having to go around is never the embarrassment," he said to me more than once. "The embarrassment is needing to go around and choosing not to."

"I think I'll still try for the runway," I said.

"Okay," he said. "Then you'd better start taking out some power."

Add power, take out power. Speed up, slow down. Climb, descend. Landing is a dance. Its orchestrations are challenging, intense and variable. If you're doing something wrong, odds are it began seven moves back. How to fix it? Dance faster, better, mightier. Or go around.



LEARNING

TO FLY

3

We floated over the highway, still being pushed to the left by the tailwind. Now, because of the added power, we were too high. Tom told me to take out all the power. We started to sink again. He warned me to keep the nose down, but not to aim for the runway. Another refrain: "You can't force an airplane to land." I thought once more about going around. Dismissed that thought. And then –

Everything happened at once.

We came down over the runway. I pulled way back on the yoke. We lurched to the right. The runway disappeared.

I mean disappeared. I was inches from concrete going 150 kilometres an hour, staring up into a windscreen full of sky. How to correct? I had no idea. The controls in my hand might just as well have belonged to a video game flashing Insert Coin Now. I stopped piloting and braced for impact.

Seconds later, Tom was calmly taxiing the two of us down runway 22.

T

om was constantly saving me from horrific landings. Over and over something went wrong. It was never the same thing twice. I came in too high. I came in too fast. I shied away from the tarmac. I lunged at the tarmac. I loved to get down really

close and then roll the plane to the right at the last second for no reason at all, and then wobble over the runway like a fledgling bird. I came in crabbed when I should have been straight, and I came in straight when I should have been crabbed. I aimed for the runway as if the plane were a dart and the runway a bull's-eye, a sensible way to land only for wheel manufacturers and slow news cycles.

When not aiming like a dart, I loved to pull up on the yoke too aggressively. That sent us back into a takeoff attitude right when we were trying to land and had no power to climb, and we flirted with a stall fifty feet in the air. No matter what the mistake was, things usually got so muddled and dire in the final seconds that I abandoned the controls out of sheer helplessness and prayed to Tom, the patron saint of hapless pilots.

To land well is to contend with paradox. You need patience when things are most hurried, composure when things are most fraught. You need focus when your attention is most scattered. You need to make small adjustments when only big ones seem appropriate. You need a light touch on the controls when the urge to yank and grip and pull them off the panel is at its strongest.

The first time I turned my attention entirely to Tom and watched him land Six-Two Romeo, I was moved to laughter by the complexity of it all. He was descending, turning the yoke, applying back pressure, lowering the flaps, adjusting the trim, pedalling the rudder, adding power, nosing down – all more or less simultaneously. How many limbs the man had! How harmoniously they moved! I was put in mind of prodigies and athletes, of the grace that remains hidden until you see a man at his calling. He was passing cool as a cucumber over I-80. He was descending to the numbers on the runway. He was riding the flare like a man in a chute. When he finally kissed the rear wheels to the runway, the tarmac was as soft as a mattress of silk.



A

fter that botched landing, I went home and reviewed landings in books and online. I watched YouTube videos of small planes coming into Caldwell.

The next time Tom and I went up, I didn't do any better. I also seemed to forget how to turn. I had co-ordinated turns down cold several lessons earlier. So why was every turn around the pattern now 45 degrees, as if I were trying to avoid enemy fire? I had a setback. A collapse. Call it what you want, I was back at square one – while also trying to land.

"Forty-five-degree turns are kind of fun," Tom said after we had returned to Fischer Aviation. "Just not in the pattern."

"Where did my brain go? Where did my feel go?"

"You were dismissing the throttle again, I don't know why. And we have to break you of pinching the yoke."

"I'm making errors because I'm pinching the yoke?"

"Yes," he said, shifting into a whisper for emphasis. "I don't make this stuff up."

"And then I get down there," I said to him about the actual landing, "and it's a complete mystery to me what I should be doing."

"Well," he said, "maybe we'll do a little sim stuff next time and we can really nail that part down. Because it shouldn't be that much of a mystery."

By then I knew that flying meant failing. I had failed at steep turns and I had failed at slow flight. I had failed to keep my altitude and I had failed to keep my heading. I'd had close calls and doh! moments, made mistakes of ignorance and mistakes of arrogance. Sooner or later, I got a handle on things. But there was something categorically different about the landing. You have to put all of the pieces together at once, with no time to spare, while staring into the dragon's mouth.

"I don't think I can solo," I said to my wife that night.

"Why not?"

"I don't want to die."

"I don't want you to die, either. Why don't you quit?"

She hated flying and had been encouraging me to quit.

"I can't quit," I said.

"Why not?"

"Because I have to solo."

But the truth is, I wanted to quit. In the endeavour to do anything difficult, I inevitably quit a hundred different times, if only mentally. Something to vent the pressure for an hour or two, until the resolve returned. My resolve was a living

EVERY ONE OF MY
LANDINGS WOULD
HAVE BEEN VERY
NASTY, IF NOT
FATAL, WITHOUT
HIS LAST-MINUTE
INTERVENTION.

thing, subject to changes in fortune. I had to tend to it, nurture it; sometimes that meant tricking it. If the temptation to quit wasn't ever-present, whatever I was doing probably wasn't that hard. One of the reasons I agreed to take flying lessons was the certainty that it would be hard. I'm a novelist; I take a perverse pleasure, obviously, in hard things. And because I knew it would be hard, I knew I would quit, at least mentally, a hundred different times.

To quit is to bow out before the achievement of a specific goal. My specific goal was to fly solo. That meant heaving Tom from the plane and heading up alone, which meant coming down alone, which meant landing alone. I could not comprehend how I ever expected myself to land without Tom beside me when almost without exception every one of my landings would have been very nasty, if not fatal, without his last-minute intervention. I knew how to take off just fine, I knew how to pilot around just fine. But landing? Oh, boy. There is an old-time humorous

placard on the walls of Fischer Aviation that reads flying lessons: 50 cents. landings: \$50. That monetises the obvious: it's the landing, stupid.

That night in October, I woke up reeling with nightmares. No one in the world but me was awake, and my ears rang with the sound of the void. My heart was doing double time. I was filled with the darkest forebodings and doubts. The only sane thing to do was retire this unhealthy pursuit. Yes, I'd been long fascinated by flight. I'd stopped in awe since I was a boy to watch planes descend overhead. But what was I trying to prove? That I could master the physical world? That as I was turning 40 I was still capable of transformation? That I was never going to die? I had watched my father die a few months earlier. Learning to fly seemed the right antidote to that gradual and ghoulish decline. A surge of power, a new strength. But at two in the morning after terrible dreams, in the abandonment of the hour, I could no longer rationalise it. This is foolishness, I thought. This is childish. Go back to getting by.

Then the weekend came. It must have restored my faith.



LEARNING

TO FLY

3

Monday was bright and breezy, blue for miles, without a wisp of cloud. I drove out to Fischer Aviation expecting a few hours on the simulator. But something happened. Were we seduced by the beautiful day? By some strain of eternal hope? Without another word about the sim, Tom and I hopped into Six-Two Romeo.

Two hours later, we came out of the sky and taxied to the apron. We walked back to Fischer Aviation in silence. Tom filled out my logbook in silence. When he finally looked up at me, he said: "Next time, we are doing the sim, rain or shine."

E

arly on, Tom tried to teach me how to do steep turns. He began with a demonstration. At a centripetally lively 45 degrees, Tom's turn consisted of a full revolution from left to right while the world unfurled like a film-strip outside the windshield. The impression was of being on a swift and steady merry-go-round. Then he handed the reins to me. On my merry-go-round, all the horses were drunk and easily spooked and occasionally had to take a knee.

We returned from time to time to the steep-turn manoeuvre. So many lessons went by. Then one day I went up and executed my first nearly flawless steep turn. I mean it had it all: an exact 45-degree bank, co-ordinated stick and rudder work, appropriate power adjustments, a continuous site picture, and the perfect maintenance of altitude and speed. I came down, not just someone capable of steep turns, but a changed man. I was high with achievement and delight, relieved of every burden.

Landings weren't like that. One thing would click into place – say, the all-important approach. Then the leveling off would go haywire. Or the flare. Or a crosswind would complicate matters. Or I'd forget how to turn.

What I did that day to convince Tom that I needed some serious sim work was aim the nose of the airplane directly at the runway. This is one certain way to put you uppermost in the minds of the National Transportation Safety Board.

"You were a little better than ninety on the airspeed indicator and just getting faster and faster," Tom informed me.

I felt the heat of indictment spread over my body. You see, I hadn't known I was aiming for the runway. It came as a complete surprise. Sure, I could see it now. I felt myself pushing the yoke forward. I felt the plane speeding up. I saw the runway getting closer and closer as I prepared to plant the nose of the plane inside the meat of the tarmac. But at the time, I believed myself to be executing a safe and proper landing.

A reversal like my co-ordinated turns suddenly going wonky on me was something I could contend with. But this startling news of Tom's was something different. At any moment, I could do something dangerous that I should not be doing without even knowing I was doing it. That was the unknown sneaking out of the darkness, a glimpse of what crouched in wait beyond the dimensions of even the best preparation.

That was enough. I was quitting. No solo. My wife was very happy. My editor was understanding. I couldn't bear to tell my flight instructor. I showed up for one final lesson, mainly to drop the news. But we went flying instead. And that was the day I had my first perfect landing.

PM



2149 CARS ONE **car**

SA'S BEST-SELLING MOTORING MAGAZINE



carmag.co.za  

Popular Mechanics

BUYER'S GUIDE



Advertiser	Page
3D Solids	96
Autostyle	103
Bestech	101
Blue Saddle Innovations	92
CCTV Systems	94
CNC Clearcut	100
CNC Instruments	102
Diesel Torque	100
Flexishield	101
Force Tools	95
Gary Lumpe	94
Hex	101
Industrial Machines	92
Instant Communication Systems	99
JG Electronics	91
Keizin	93
Lock Latch	92

Advertiser	Page
Little Boy Blue	101
Lopez Auto Trading	92
Lynx Optics	97
Minelab	96
Off Shore	92
PicC	99
Planet Electronics	102
Polygon	98
Power House Auto	102
Pro Auto Rubber	99
Redline	92
Securitek	101
Strongman	96
Summit	102
Van Acht Wooden Windows	98
Vermont	94
Voice Alert	98



Make Money Today! Start Your Own Business!



Tiles • Tshirts • Plates • Smartphone covers
• Mousepads etc



Button Badges
25mm • 37mm
• 56mm



Awards • Trophies
• Fine Sandblasting
• Photo's on Tombstones



Vinyl stickers • Tshirts •
Engraving • scrapbooking etc



ELECTRONICS

USA

A NEW WINDOW TO THE WORLD OF Gaskets

- PREMIUM QUALITY (apprvd by C.A.E)
- COSWORTH TESTED (Burton Power U.K)
- REUSABLE with built in O-rings (no groove needed)
- ALUMINIUM/COPPER/STAINLESS STEEL
- SEALING PRESSURE up to 7 times MORE
- COMPRESSION RATIO raised or lowered
- LARGE BORE SIZES
- TURBO/NITROUS/ALCOHOL
- CUSTOM BUILT

Contact: Redline Engineering
Tel: 021 556 5764 or 072 1433 773
www.redline-engineering.com

New LOCKLATCH

Leave your windows and doors open, BUT LOCKED!




www.locklatch.co.za 082 447 2809
patenting: PCT/1B2014/060903

Full Business - 6 Machines R20500 incl

MAKE SOCCER KITS, CAPS, Signage on CARS/SHOPS, TOMBSTONES



630mm Vinyl cutter for Signage / Tombstones, Banners
Cap Press T-Shirt Press Soccer & T-Shirt & Overalls
Plate Press Sublimation Printer Mug press

3 Machines Combo R15000 incl Vat



8in1 Combo Press plates / tiles / puzzles mugs/ t-shirts
Sublimation Printer Vinyl Cutter Sublimation Consumables

4 Color T-Shirt Screen Printer R12000 incl VAT



Photobook Maker A3 R13000 incl Heavy Duty Guillotines A3 R4200

www.vinylcutters.co.za 0843048133
COUNTRY - WIDE DELIVERY

Coin & Card based Light-control. For convenience and 100% cost recovery.

APPLICATIONS INCLUDE:

- > Squash/Tennis Court Lights
- > Pool Table Lights
- > Sunbeds
- > Power supply to Car Wash Pumps
- > Self-service Laundromat Machines
- > Gaming Stations
- > Boom Access-Control



BSI BLUE SADDLE INNOVATIONS
UTILITY COST RECOVERY AND PRE-PAID SOLUTIONS

CONTACT
082-390-7390
011-792-5869
sales@bsinnovations.co.za
www.bsinnovations.co.za

OPEL & CHEV SPARES AT AFFORDABLE PRICES

OPEL & CHEV USED PARTS



LOPEC AUTO SPARES

www.lopec.co.za
sales@lopec.co.za
T: 011 894 1322 / 011 394 5987
F: 086 557 1717
26°11'38"S 28°16'18"E
Unit 14, Middle Office Park, Top Road, Anderbolt Boksburg



Coming from Main Reef Road

Like @LopecAutoSpares

Upgrade to an electronic ignition...

IGNITOR fits 4.6 & V8 engines From R790 incl VAT 30 month warranty

fits entirely inside the distributor - installs as quickly as changing a set of points!
Add up to 20 horsepower



SAVE PETROL

IGNITOR
Never Change Points Again!
www.pertronix.com

CONTACT THE AUTHORISED SOUTHERN AFRICAN IMPORTERS
OFFSHORE MARINE INTERNATIONAL

Tel/Fax (021) 786 1007
Cell 082 491 8536
E-Mail: omiintl@mweb.co.za
P O BOX 625 Simonstown 7995

Maximising the appearance of your car starts with the wash.

STEP 01.
WASHING

STEP 02.
CLEAN & PREP

STEP 03.
POLISHING

STEP 04.
PROTECTING

STEP 05.
MAINTAINING

Make it a Family Affair!

Meguiar's
since 1901




A2516

G7116

G10464

G12664

G17748

Join the fan club  MeguiarsSA

Find a stockist near you, shop online
or join our forum on www.keizin.co.za

Tel: 0861 CAR GUY [227489] Email: info@meguiars.co.za

Meet our car wash family: Meguiar's, the world leaders in car care, have formulated car wash products that gently and effectively strip away dirt without removing wax protection, leaving a slick and glossy finish.

It doesn't get better than this!

KEIZIN
AUTOMOTIVE

Tork CraftTM

Power Tool Accessories

MINI TOOLS



TC08172
Mini Rotary Tool 8,000-32,500 RPM
172 Popular Accessory pieces
Compatible with all makes of mini tools



TC08051



TCMT001

Vermont Sales

SOUTH AFRICA'S #1 SUPPLIER (Pty) Ltd
of power tool accessories
Powered by Service
For your nearest dealer call us on 011 314 7711
www.vermontsales.co.za

CCTV Systems

4 camera set **R1650**
4GB Spy watch **R550**
8 camera set with hard drive **R2999**

View your home on your Smartphone anywhere in the world.



info@cctv-direct.co.za • www.cctv-direct.co.za

KNIPEX

PREMIUM QUALITY PLIERS, CRIMPERS & TOOLS SINCE 1882
www.knipex.com

wiha

PREMIUM QUALITY SCREWDRIVERS & HEX KEYS SINCE 1939
www.wiha.com

RENNSTEIG TOOLS

MADE IN GERMANY
LIFETIME WARRANTY
www.rennsteig.com

EXECUTIVE

PREMIUM QUALITY TOOLKITS

IREGA

MADE IN GERMANY
LIFETIME WARRANTY
www.irega.es

RENNSTEIG TOOLS

PREMIUM QUALITY CHISELS, PUNCHES & SDS BITS
MADE IN GERMANY
LIFETIME WARRANTY

IREGA

PREMIUM QUALITY SHIFTING SPANNERS
MADE IN SPAIN
LIFETIME WARRANTY

GARRY LUMPE IMPORTS

TEL: 0861 237770

FORCE PROFESSIONAL TOOLS

144 Nolte Road
Bartlett
Boksburg
1459
Tel : 011 826 0024
0861 1FORCE
0861 136723
Fax : 086 771 4058
Email : showroom@forcetools.co.za
Website : www.forcetools.co.za



@ForceTools



facebook.com/ForceTools



Our tools are available
for purchase on

takealot .com

Black Suitcase With 107pc Tools (Metric)

50234-107



14-6pt. Flank socket 3,2;4;5;5;
5,5;6;7;8;9;10;11;12;13;14 mm
20-1/4" bit 25mmL
Slotted 4; 5,5; 6,5 mm
Hex 3; 4; 5; 6; 8 mm
Phillips PH.1; PH.2; PH.3
Pozidriv PZ.1; PZ.2; PZ.3
Star T10;T15;T20;T25;T30;T40
1-Flexible bit ratchet handle for
1/4" inhex
2-Extension 2" & 6"
1-Universal joint
1-Bit Adaptor 1/4"Hex x 1/4"Sq
1-Spinner
1-Adaptor for extension 3/8"(F)x1/4"(M)
1-Magnetic socket pick up
10-1/2"DR. 6pt. Flank socket
10; 12; 13; 14; 15; 17; 19; 21;
22; 24 mm
1-Engineer hammer 300gw
1-Rubber hammer 400gw
1-Dynamo LED torch
1-1/2"DR 24 teeth Ratchet handle
1-Mini hacksaw 6"
2pc Saw blade
1-5m measuring tape
1-Auto center punch12325 04...065
1-Utility knife (incl. 2pc blades)
1-Chisel 12mm (150mmL)
1-Cape chisel (150mmL)
1-Pin punch 4mm (190mmL)
1-Taper punch 3mm (185mmL)
1-Center punch 4mm (185mmL)
1-Locking pliers 10"
10-Hex ball point long key
1,27;1,5;2,2;5;3;4;5;6;8;10 mm
11-Combination wrench
8;10;11;12;13;14;15;17;19;
21;22 mm

2-Insulated phillips screwdriver
PH.1; PH.2
4-Insulated slotted screwdriver
3; 4; 5,5; 6,5mm
1-Stubby phillips screwdriver PH.1
1-Stubby slotted screwdriver 6,5 mm
3-Phillips screwdriver PH.1;PH.2;PH.3
1-Induction circuit tester

1-Insulated water pump pliers (curved jaw) 10"
1-Adjustable gauged wrench (250mmL)
1-Insulated long nose pliers 6"
1-Insulated combination pliers 7"
1-Insulated diagonal cutting pliers 6"
1-Insulated wire stripper pliers 6"

**Perfect For Travel And
On The Move Repairs**

**Now Only
R3950
While Stocks Last**

Black Suitcase With 107pc Tools (SAE)

50234-107



14-6pt. Flank socket: 5/32"; 3/16";
7/32"; 1/4"; 9/32"; 5/16"; 11/32";
3/8"; 13/32"; 7/16"; 15/32"; 1/2"; 9/16"
20-1/4" bit 25mmL
Slotted 4; 5,5; 6,5 mm
Hex 1/8"; 5/32"; 3/16"; 1/4"; 5/16"
Phillips PH.1; PH.2; PH.3
Pozidriv PZ.1; PZ.2; PZ.3
Star T10;T15;T20;T25;T30;T40
1-Flexible bit ratchet handle for
1/4" inhex
2-Extension 2" & 6"
1-Universal joint
1-Bit Adaptor 1/4"Hex x 1/4"Sq
1-Spinner
1-Adaptor for extension 3/8"(F)x1/4"(M)
1-Magnetic socket pick up
10-1/2"DR. 6pt. Flank socket
10; 12; 13; 14; 15; 17; 19; 21;
22; 24 mm
1-Engineer hammer 300gw
1-Rubber hammer 400gw
1-Dynamo LED torch
1-1/2"DR 24 teeth Ratchet handle
1-Mini hacksaw 6"
2pc Saw blade
1-5m measuring tape
1-Auto center punch12325 04...065
1-Utility knife (incl. 2pc blades)
1-Chisel 12mm (150mmL)
1-Cape chisel (150mmL)
1-Pin punch 4mm (190mmL)
1-Taper punch 3mm (185mmL)
1-Center punch 4mm (185mmL)
1-Locking pliers 10"
10-Hex ball point long key
1/16"; 5/64"; 3/32"; 1/8"; 5/32"; 3/16";
1/4"; 5/16"; 3/8"
11-Combination wrench
1/4"; 5/16"; 3/8"; 7/16"; 1/2"; 9/16";
5/8"; 1/16"; 3/4"; 13/16"; 7/8"

2-Insulated phillips screwdriver
PH.1; PH.2
4-Insulated slotted screwdriver
3; 4; 5,5; 6,5mm
1-Stubby phillips screwdriver PH.1
1-Stubby slotted screwdriver 6,5 mm
3-Phillips screwdriver PH.1;PH.2;PH.3
1-Induction circuit tester

1-Insulated water pump pliers (curved jaw) 10"
1-Adjustable gauged wrench (250mmL)
1-Insulated long nose pliers 6"
1-Insulated combination pliers 7"
1-Insulated diagonal cutting pliers 6"
1-Insulated wire stripper pliers 6"

Power you on

**Now Only
R3950
While Stocks Last**

TURN METAL INTO MONEY

MAKE: RACE CARS • FURNITURE • TRAILERS • SECURITY DOORS • JUNGLE GYMS • FARM EQUIP

BEND & ROLL to 50 mm tube! Also Scrollers * Twister * Tube Notchers * Brake Press * Shear

Multi Bend System



Ring Rollers



Scrollers



Twister



Press



- > Delivered to your Door!
- > Built to Last
- > Easy to Use
- > Spares and Support

**PROJECT IDEAS
AND INFORMATION**
www.strongman.co.za



GET YOUR INFO PACK NOW!

Call Andries on 083 327 9988
SMS "PM" & your email address to 083 327 9988
or Email info@strongman.co.za
strongmantools@gmail.com
Visit our Demo Centre in Heidelberg



CTX 3030

The Future of Discovery



The waterproof all-terrain CTX 3030 is the ultimate TREASURE detector.

Contact Minelab South Africa
Zambesi Drive, Sinoville, Pretoria, South Africa
Tel: George +27 (0) 83 702 0312 or Quintin +27 (0) 82 319 3831 or Werner +27 (0) 82 2622 278
Email: info@minelab.co.za Web: www.minelab.co.za

Adventure Detectors | Treasure Detectors | Gold Detectors

FBS2 Smartfind2 GRSI WISDOM
World's Best Metal Detection Technologies







Additive Manufacturing Technology

ULTEM 9085 Parts



Courtesy of Aerosud ITC



Exclusive Stratasy's Certified System Engineers for all Fortus and Dimension 3D Systems

3D Solids Additive Manufacturing Technology

At the core : Advanced FDM (Fused Deposition Modeling) Technology
Now produce usable parts in high strength engineering thermoplastics

Two NEW Systems announced by Stratasy's - December 2014

Next generation : FORTUS 380mc & FORTUS 450mc

PRODUCE PRODUCTION PARTS
AHLAC, a South African designed and build aircraft has 61 components printed on the FORTUS System, in ULTEM 9085 Aerospace grade thermoplastic.



New Touch Screen Interface



Stratasy's

GOLD PARTNER | 2015

www.3dsolids.co.za

Fortus 380mc, 450mc & 900mc :
Produce production parts in a wide range of thermoplastics - ABS-M30; PC; PC-ABS Nylon 12; Ultem 9085; and more.

Fortus 250mc : Entry level Fortus System

Dimension Elite : 3D Printer - Prints in Fine & Standard Resolution.

Dimension SST1200es : Builds large, functional, durable 3D models

uPrint SE Plus : Easy on your budget.

For detailed information contact
Russell Oosterlaak
Tel : 012 345 5112
Email : margie@3dsolids.co.za

SEE IT **ALL** THE TIME.

With our range of night vision devices, trail cameras and hand held searchlights, neither dark nor distance will keep you from keeping an eye on every detail. Proudly distributed by Lynx, you can be sure of the quality and quick local support that has become synonymous with our name.



LIGHTFORCE CORDLESS ENFORCER*

- 30-watt Xenophot bulb for primary illumination
- Low energy 3 LED task light
- 140 mm, 170 mm and 240 mm diameters
- Focus from a pencil beam to a spot

*Product may differ from picture



RANGER MOTION ACTIVATED CAMERAS

- Day & night (low glow IR flash available on some models)
- Photo / video
- SMS / e-mail notification¹
- Up to 32 GB memory
- Weatherproof

¹Available on all models, requires optional transmitter module



xGEN DIGITAL NIGHT VISION VIEWER

- Up to 70 metres
- Compact and lightweight
- Infrared illuminator
- 3x - 6x magnification



Visit www.lynx.co.za or contact us for specifications and options.
info@lynx.co.za • tel 011 792 6644 • fax 011 792 8923

BE SURE TO LOOK INTO LYNX



VAN ACHT
WOOD • ALUMINIUM • WINDOWS • DOORS



Frameless Folding Doors
Enclose your Patio !

Randburg, Kya Sand 011 708 2488 | Krugersdorp 011 664 7192 | Montana 012 548 7672
Hartbeespoortdam 012 244 1319 | Klerksdorp 018 462 0784 | Rustenburg 014 596 6353

f. 011 708 2023 | sales@vanacht.co.za
www.vanacht.co.za

Automate your site

The GSM Commander turns:

- Your farm into a factory,
- Your phone into a control panel,
- Your nightmares into sweet dreams..



Secure your home
Monitor tanks
Control pumps, pivots
Detect cable theft
Protect solar panels
Notify you of events
- and so **much** more...

The GSM Commander uses a standard SIM card to communicate to your phone or to the Internet. It uses the award-winning **SmartSetup®** software to allow it to do so much more than merely communicate...
Call us with your unique problem, and we will **invent** a solution for you..



Developed and manufactured
and supported in South Africa

Tel: +27-(0)21 9817062
Email: info@gsmcommander.com

WWW.GSMCOMMANDER.COM

VOICE ALERT!

**Keeping You Safe
When You're Home**



**Voice Alert's wireless
outdoor sensors tell you
exactly where the
Intruders are discreetly
in your own pre-recorded
voice from the portable
device, for example:
"Intruder in Back Yard"**

**Like our Facebook
Page Voice Alert Africa
and stand a chance to win
a VoiceAlert Starter Kit.**

021 781 0080
info@voicealert.co.za
www.voicealert.co.za



**RUBBER &
PLASTIC**
EXTRUSION &
MOULDING

Call **STEPHAN** on **082 418 8397**



SMSALERT
A PIC ELECTRONICS PRODUCT

**SMS ALERT PORTABLE
STAND-ALONE ALARM**

- PORTABLE ALARM SYSTEM
- SMS UP TO 4 CELLPHONES WHEN ALARM IS TRIGGERED
- ACTIVATES PEPPER GAS AND SIREN
- DIY, PLUGS IN AND READY FOR USE
- 2 BUTTON REMOTE (ARM/DISARM & PANIC)
- LISTEN-IN MICROPHONE
- MAINS POWER FAILURE & RECOVERY NOTIFICATION
- 6 HOUR BATTERY BACK-UP
- 1 OUTPUT EG. REMOTELY OPEN GATE OR TURN LIGHTS ON/OFF
- SOLAR PANEL INPUT
- EXPANDABLE OPTIONS



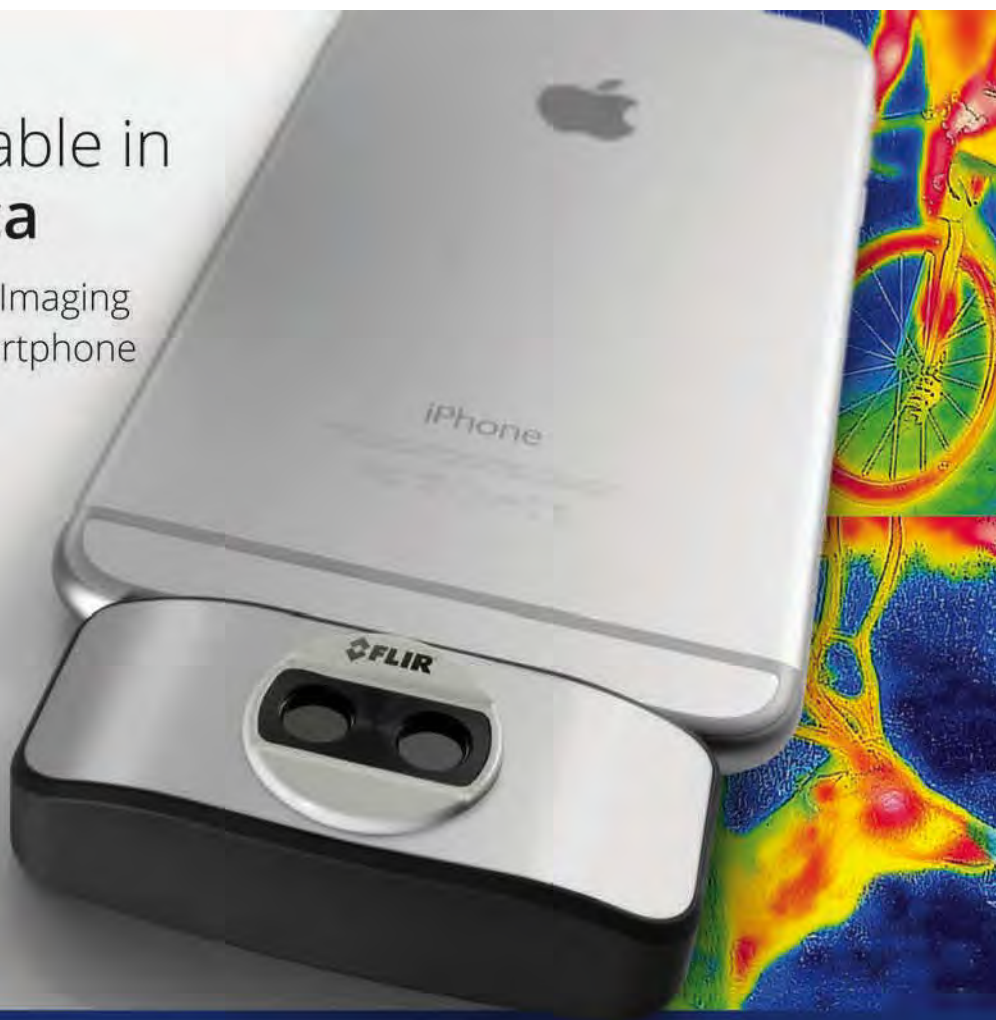
R3995

hester@smsalert.co.za 011 202 5884

Finally available in
South Africa

A Personal Thermal Imaging
Device for Your Smartphone

FLIR ONE



Visit www.flirafrika.co.za for more information.



PowerBox & PedalBox

The best way to optimise your vehicles performance

Our performance systems are always at the cutting edge of quality, form & function.

The new **PowerBox** & **PedalBox** are supplied as complete systems with vehicle-specific software and OEM quality adapter looms.

Detailed, illustrated instructions are provided to assist with the simple, plug-in, installation.

ORDER NOW
021 556 6463

PowerBox & PedalBox by DIESEL TORQUE
 Phone 082 379 6141 or 083 298 8544
 Mail info@dieseltorque.co.za
 Web www.dieseltorque.co.za
www.pedalbox.co.za

BETTER POWER OUTPUT

MAXIMUM PERFORMANCE

CONSUMPTION OPTIMISATION

up to **30% more POWER**

up to **20% less FUEL**

Get the latest technology NOW!

- > Surface mounted Keypad ✓
- > Lifetime Warranty ✓
- > Ultra-High-Speed-Processor ✓
- > Simple Plug-in installation ✓
- > Multi-Map-Technology ✓
- > Made in Germany ✓

<p>PowerBox for Cars</p> <p>Turbo Diesel from R1995</p> <p>Turbo Petrol from R3995</p> <p>Petrol from R2995</p>	<p>PowerBox for Trucks</p> <p>Turbo Diesel from R4995</p> <p>PowerBox for Tractor</p> <p>Turbo Diesel from R4995</p>
--	--

PedalBox for Cars, SUVs, Vans, Trucks...

Diesel & Petrol from R2250

CNC CLEAR CUT

CNC PLASMA CUTTING TABLES

WORKSHOP CNC PLASMA CUTTER

OPEN DAY BRAAI!
 13 July 2015
 Register today (online or by mail)
 and stand a chance to win a
 Pmx30 hand plasma system
 valued at **R37 000**

R234 000
 excl. vat

FEATURES

- 2.5m x 1.3m sheet size
- Pierce Capability of 10mm
- Magnetic torch breakaway
- Auto Torch High Control
- Water Bed



CNC CLEAR CUT WS

Training, support, service and consumables readily available.
 Contact us for our Industrial HI definition systems up to and over 12 x 2.5 meters; 50mm cutting thickness.

South Africa's Leading CNC Plasma Table Manufacturer

Tel: +27 12 541 0552
 e-mail: enquiries@cncclearcut.co.za
 registration: openday@cncclearcut.co.za
www.cncclearcut.co.za



BROWSE YOUR BIKE

GS-911wifi
Diagnostic Tool for BMW Motorcycles
shop.hexdiagnostics.co.za | Tel. 021 850 0650

CFP TECHNOLOGIES
Electric motors & Drives
Speed Control for your Machinery,
Pumps, Conveyors, Fans, Mixers, etc

Variable Speed Drives for Electric Motors (VFD's or VSD's)
Single phase input, three phase output models. 0.18 Kw - 4 Kw
Three phase input, three phase output models. 0.18 Kw - 1000 Kw

Electric Motors
Single Phase: 0.12 Kw - 7.5 Kw Three Phase: 0.18 Kw - 330 Kw



Website: www.cfptech.co.za
Email: cjvdb@mweb.co.za
Tel: 082 8570324

RAPID PROTOTYPING
by 3D Printing
Take your 2D design ideas and turn them into 3D reality.
Convert what you can see into what you can hold.

Liquid EDGE
2D 3D



www.liquid-edge.co.za
Marilyn: 072 460 1996

ARE YOU USING PROTECTION?
www.flexishield.co.za



Flexi Shield™
We've got you covered!

Since 1996
Ask for it by name!

ISO 9001

<http://www.facebook.com/FlexiShield>

Protect your vehicle from stone chips
and sand blasting!
Precut kits = **No trimming on Vehicle**



Head Office: (Vaal)
We have Fitment Centers In The Following Areas:
Germiston Pretoria
Hazeldean Namibia
Randburg Cape Town

Phone Head Office
For Your Nearest Fitment Centre

016-421 3735

BesTech
Since 1983

Quality • Safety • Comfort

Rearview Mirror Cameras



- Protect your loved ones
- Reversing and parking made easy
- Prevent costly damage

Hands-Free Car Kits



BURY TECHNOLOGIES

- The driver's attention is not distracted
- User friendly
- Drive and talk without the risk of fines

Park Distance Control



- Protect your loved ones
- Prevent costly damage
- Reversing and parking made easy

Cruise Control



- Reduce driving stress
- Improve fuel economy
- Avoid unintended speeding fines

Electric Windows



- No more winding or stretching to reach window winder handles
- Universal and Factory replacement type available
- Close windows quickly at the touch of a button

Tel: 0861 220 220 • www.bestech.co.za

WWW.

.CO.ZA

CNC-STEP

CNC MILLING • ROUTING • PLASMA

Machines that make the cut!

Wide range of machines from bench-top to large industrial



CNC Tools
High Quality Tooling Online

Online router cutting bit shop for routing tools and cutters
www.cnctools.co.za

High quality CNC machines
made in Germany

Agents: **CNC Instruments CC**
Contact: 073 277 6582 or 079 884 8453
Email: info@cnc-step.co.za
www.cnc-step.co.za

Barnett

auto spares

THE LEADER IN NEW & USED TOYOTA SPARES



Knock Sensor - All Toyota's



Fan Belt Tensioner
Corolla ZZ



HILUX VVTI Ignition



ABS Sensor - Yaris & Corolla



New doors in stock

Yaris Hbk/Sdn, 09 Corolla,
Hilux S/D Cab



Slip Ring - All Toyota's

27 Roadhouse Crescent, Briardene - 031 579 4786
www.barnettspares.co.za



The pinnacle of brake and
steering expertise.

375 Rivonia Boulevard, Rivonia.

Tel: (011) 803-6500

CASKA

Custom-made car multimedia
& navigation systems

- 7" HD digital touch screen 800x480 resolution
- Navigation with TomTom mapping
- Compatible with all iPhone / iPod modules (30 pin connector - lightning connector requires a 30 pin adaptor)
- Built-in handsfree Bluetooth
- Integrates with steering wheel controls
- Plays CD, VCD, DVD, MP3, MP4, Div-X, etc.
- RDS Radio with preset stations
- Built-in music hard drive

Optional Extras

- TPMS / PDC / Reverse Cam / Tracks4Africa

Maps by
TomTom

Distributed by

PLANET
ELECTRONICS
Intelligent Accessories

0860 65 64 63 info@planetworld.co.za / www.planetworld.co.za

NEW **FORD RANGER MODEL** NOW AVAILABLE
MANY MORE MODELS AVAILABLE!

SMS "BUNDLE" TO 33075
TO GET AN INSTANT QUOTE
SMS's cost R1.50 per SMS



Autostyle Motorsport

Autostyle Gauteng
83a Church Street, Mayfair, JHB, Gauteng
Tel: 011 661 1700
Fax: 011 837 3116

Autostyle Kwazulu-Natal
1-3 Jubilee Grove, Gateway Autocity, Umhlanga-Ridge, Kwazulu-Natal
Tel: 031 566 5099
Fax: 031 566 3473

WWW.AUTOSTYLE.CO.ZA



Original Plasti-Dip Range of Liquid Vinyl Sprays & Paints - from R150

NATIONWIDE DELIVERY! OPEN 7 DAYS! WE BEAT ANY PRICE! 

 <p>Philips Philips Bulbs Now Available WhiteVision, BlueVision & X-Treme Vision from R295set</p>	 <p>Xenon HID Headlight Kits H1, H7, H3 & H4 from R495set Philips HID Kits Now Available from R1195set</p>	 <p>Carbon Shields Bonnet Guard - R320 Headlight Shields - R240 Windshields - R190set</p>	 <p>Assorted DRL Style LED Headlights from R1395set</p>	 <p>Lamin-X Films 60x30cm Assorted Colors - R225ea Custom Sizes can be cut</p>	 <p>Auto Gauge Assorted Design Autogauge Performance Gauges Boost Gauge - from R180 Oil Pressure - from R180 Oil Temp - from R180 Tachmetres, Shiftlights and many more available</p>
 <p>Bodykits and Spoilers Available for most cars</p>	 <p>Non Reclinable Racing Seats R850ea  <p>Reclinable Racing Seats Including Rails Exclusive Design! R2395pair</p> </p>	 <p>Evo 3 Bike Carrier R495 Thule Range Now In Stock!</p>	 <p>Cobra ESD-7570 Laser & Radar Detector - R850</p>	 <p>Duplicolor Interior Vinyl & Fabric Spray R90</p>	 <p>RaceChip RaceChip Upgrade Chip 30% More Power! 26% More Torque! Up to 1l/100km fuel less consumption! Racechip 1 - R3350 RaceChip Pro 2 - R4350 Racechip Ultimate - R6350</p>
 <p>Camtec Media Player with USB & Front Aux R295</p>	 <p>Pioneer DEH-155MP Front Loader with Front Auxiliary input R695</p>	 <p>Paramount DVD with 7" Screen & USB - R2250</p>	 <p>Sony CDX-G1151u Mp3 Front Loader with USB & Front Auxiliary R795</p>	 <p>ICE Power DVD/Mp3 Cd Front Loader with 3" Screen R950</p>	 <p>JVC KW-R510 Double Din Mp3 with USB and Front Auxiliary R1595</p>
 <p>Targa Amplifiers 1500w 2channel - R495 3000w 4channel - R695 5000w 4channel - R995</p>	 <p>Starsound Double Din DVD & GPS R2400</p>	 <p>Pioneer 12" 1000w - R495 12" 1400w - R580 12" 1400w DVC - R695</p>	 <p>Roofmount Screens 7" - R795 8.5" - R850 13" - R1295 12" - R1095 15.4" - R1695 17" - R2100 19" - R2800 22" - R2995</p>	 <p>Starting Grid Starting Grid Audio Combo - includes: 4000w 4ch Amp, 12" 1200w Subwoofer + 12" Sub Enclosure + 300w Tweeters + 600w 6x9" Speakers R1195set</p>	
 <p>15" Evo Lumar Alloys 4/100 & 4/114pcd R3395 set of 4</p>	 <p>Evo BBS Alloy Wheels 4/100, 4/108, 5/100 & 5/114 15" R3395 17" R4495</p>	 <p>17" Evo Questa Alloys 4/100pcd R4395 set of 4</p>	 <p>Evo Catania Alloy Wheels 4/100 & 4/114pcd 15" R3495 17" R4395</p>	 <p>Evo VS Style Gunmetal 17" 5/100 R4795 19" 5/112 R5495</p>	 <p>20" A-Line Viper Alloys 5x114 & 5/120 pcd R8400 set of 4</p>

DUNLOP YOKOHAMA PIRELLI WANLI accelera KENDA EVO

WHEEL & TYRE FITMENT CENTRE OPEN SEVEN DAYS!
Opposite Autostyle JHB Store.
ALLOY WHEEL & TYRE FITTING, BALANCING, STRIPPING

EVO TUNING

ALL OUR ALLOY WHEELS ARE SUPPLIED "COMPLETE" INCLUDES BOLTS, NUTS, SPIGOTS, CENTER CAPS, VALVES AND VALVE CAPS

13 & 14" TYRES	15 & 16" TYRES	17" & 18" TYRES	4x4, 19" & 20"
155/70/13" - Dunlop - R450	185/65/15" - Dunlop - R650	205/45/16" - Kenda - R740	225/35/19" - Yokohama - R1695
155/80/13" - Dunlop - R420	195/50/15" - Sava - R540	205/40/17" - Wanli - R620	235/35/19" - Achilles - R1295
175/50/13" - Yokohama - R850	195/50/15" - Dunlop - R620	205/40/17" - Dunlop - R695	235/35/19" - Yokohama - R1695
175/70/13" - Dunlop - R399	195/50/15" - Pirelli - R740	205/40/17" - Pirelli - R920	265/30/19" - Accelera - R1900
175/70/13" - Sava - R425	195/50/15" - Yokohama - R680	205/40/17" - Yokohama - R895	225/30/20" - Wanli - R1295
165/80/13" - Sava - R370	195/55/15" - Dunlop - R680	215/45/17" - Kenda - R780	
	195/60/15" - Pirelli - R750	225/45/17" - Accelera - R895	
	195/60/15" - Dunlop - R670	225/45/17" - Yokohama - R1150	
	195/65/15" - Dunlop - R640	235/45/17" - Wanli - R890	
	205/60/15" - Dunlop - R730		
		215/35/18" - Accelera - R980	Bakkie and 4x4/SUV Tyres
		225/40/18" - Wanli - R895	195R14" - Wanli - R780
		225/40/18" - Dunlop - R950	215/R15" - Dunlop - R1200
		225/40/18" - Yokohama - R1295	195R15C - Dunlop - R1050
		235/40/18" - Kenda - R1450	235/65/17" - Wanli - R1295
		255/35/18" - Wanli - R1150	275/40/20" - Achilles - R1850
			275/45/20" - Achilles - R1850



WINNING TIP

GRIND YOUR OWN

I replaced tap washers, only to see the taps leaking again the next day.

For me, that's no problem: turn it tight enough and it will stop leaking. Unfortunately that leaves my wife and kids unhappy, because they cannot open the taps when I am done.

Upon closer inspection of the offending taps, I noticed the washer seats were badly corroded after years of service. A tap washer seat grinder is available on the market, but for the price of two new taps.

My DIY solution involves an M4 x 50 mm bolt and nut (it should match the hole in the tap washer – M5 for bigger taps), a tap washer, correct size metal washers and 200-, 400- and 800-grit waterproof sandpaper.

Push the bolt through the sandpaper, followed by a rubber washer, a metal washer roughly the same size as the rubber washer to prevent distortion and finally the bolt. Insert your new tool into a cordless drill and gently grind the tap washer seat with 200-grit paper, followed by the finer paper in order. Use the drill in reverse (anti-clockwise) to prevent the nut from coming undone.

I got the job done for R30.

MARIO HEYDENRYCH
CENTURION



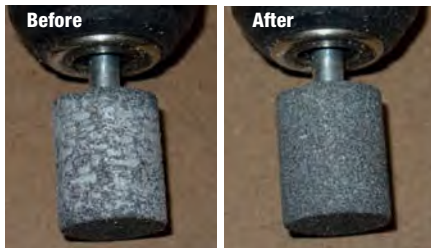
SEND US YOUR HINT - AND SCORE!

Send us your best home, garage workshop and general DIY hints – and win! This month's best tip wins a **Makita DHP453RYEX 13 mm lightweight 18 V cordless Impact Driver Drill kit** worth **R5 719**. Powered by a 1,5 Ah Li-ion battery, this variable-speed model delivers up to 19 500 impacts per minute. It features an electric brake, drill mode and 16 torque settings with a maximum fastening torque of 42 N.m Hard and 27 N.m Soft. Supplied in an aluminium carry case with two 1,5 Ah BL1815N batteries, it comes with a fast charger DC18RC and a drawer filled with handy accessories. The 1,5 Ah battery re-charges in about a quarter of an hour. The "Big Brothers" – 3,0 Ah and 4,0 Ah batteries – will fit this model and can be purchased separately.

To find out more about Makita Power Tools, visit www.makita.co.za or www.facebook.com/MakitaPowerToolsSA.

Send your tips to:

PM Do It Your Way, Box 180, Howard Place 7450, or e-mail popularmechanics@ramsaymedia.co.za. Please include your name, address and contact number. Regrettably, only South African residents are eligible for the prize. Prizes not claimed within 60 days will be forfeited.



CLEANING A GRINDING WHEEL

Plastics are difficult to work with if you need to widen a hole or make a specific cutout using power tools. Working with ABS or polycarbonate material using a grinding wheel to remove small amounts of plastic is problematic. Even though one might have selected a very low speed on the power drill, the grinding stone heats up the plastic and the grinding bit gets gummed up to the point of not working at all. One is faced with the task of cleaning the grinding bit regularly.

I could not find a satisfactory solution on the Internet and thought, why not use a heat gun to melt the plastic on the grinding bit? The heat contracts the plastic into small balls, which then can easily be removed by rubbing your finger over the surface area of the grinding bit. (See before and after pictures.)

ANDRE SPAMMER
PRETORIA

HOLES MADE EASY

When reaming a hole, especially in steel, I have tried stone and other reamers with little success. My tip: take a round file (old or new, it doesn't matter), cut it into pieces with a baby grinder and use it in your drill in forward and reverse.

JACQUES DE WET
GREAT BRAK RIVER



PLUG POWER

I'm sure at some time every DIY buff has had this problem: although you've taken care to drill the right-size hole to suit the plug, when the plug is inserted it's loose in the hole. Either it just turns, or it pulls out as you tighten the screw. This happened to me the other day in a situation where I couldn't reposition the hole and try again; I had to be able to use the hole I had drilled. I was using an 8 mm plug, so I cut a 6 mm strip of 120 grit water paper, folded it over the plug and pushed it into the hole.



This time it was tight and I had to tap it home. It held perfectly and I was able to get a really good fix with the screw.

ROSS WILSON
CENTURION **PM**

RESERVATION OF COPYRIGHT

The publishers of POPULAR MECHANICS reserve all rights of reproduction or broadcasting of feature articles and factual data appearing in this journal under Section 12 (7) of the Copyright Act, 1978. Such reproduction or broadcasting may be authorised only by the publishers of POPULAR MECHANICS. Published by RamsayMedia Pty Ltd for the Proprietors, POPULAR MECHANICS (SA) Pty Ltd, Uitvlugt, Howard Drive, Pinelands, Western Cape. Distributed by RNA, 12 Nobel St, Industria West, Johannesburg, and printed by CTP Gravure, 19-21 Joyner Road, Prospecton, Durban. Apple Mac support: Digicape tel 021 674-5000.



CAPE **HOMEMAKERS** *expo*

create | decorate | renovate

27 - 30 Aug
CTICC

Thurs to Sat: **10h00 - 20h00** • Sun: **10h00 - 18h00**

Adults: R70 • Pensioners: R50 • Children under 12: Free

Tickets available at webtickets.co.za

web tickets

www.homemakersonline.co.za

$$\rho\sqrt{\sigma}m/5\Sigma$$

Education brings promise

Investec Promaths and Bursary programme is celebrating 10 years of believing in more.

Together with the commitment of our partner organisations, we have given more time, more support and more attention to promising students and learners in order to equip them for the bright futures they deserve. This initiative has grown enormously over the past decade and has all the right elements to continue to produce out of the ordinary results in the future.

investec.co.za



Out of the Ordinary®

 **Investec**

Specialist Banking / Asset Management / Wealth & Investment